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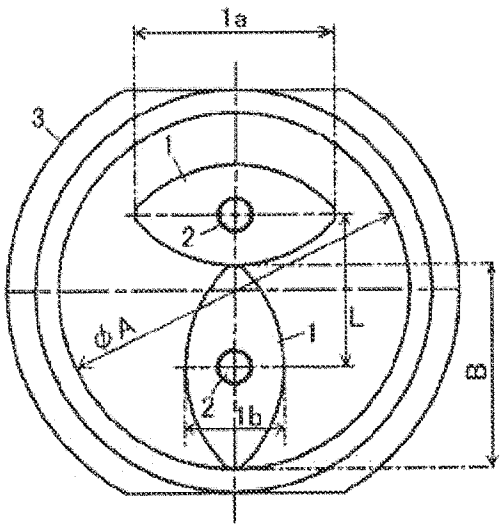
(54) TWIN-SHAFT STIRRING APPARATUS

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a shape of paired stirring blades, which can certainly prevent the rotation of a stirred fluid together with the rotation of the brades and can certainly prevent a part adhering to the surfaces of the stirring blades not to be stirrece from occurring, in a stirring apparatus for a highly viscous fluid with twin-shaft stirring blades.
SOLUTION: In the stirring apparatus, a pair of vertical stirring blades 1 are rotate on their axes in a vertical stirring tank 3 to stir/mix the highly viscous fluid in the stirring tank, the horizontal cross section of the stirring blade 1 is almost an oval shape having its center at a vertical shaft 2 and the sum of the half of a major axis of the oval shape and the half of a minor axis thereof is equal to the distance between the shafts. One stirring blade 1 and the other stirring blade 1 are shifted by 90° in rotary phase and rotated at an equal angular speed in the same direction. The side curved surface shapes of the stirring blades are set so that the leading end part of one stirring blade 1 has a shape almost coming into contact with the side surface part of the other stirring blade 1 at the whole rotary position.



* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1]
In an agitating device for which a vertical-axis impeller of a couple is made to rotate within a mixing vessel every length, and high viscous fluid in the above-mentioned mixing vessel is agitated and mixed,
a horizontal section of an impeller centered on a vertical axis -- it is elliptical mostly
One half of the sums of one half and minor-axis length of the major-axis length elliptical [above-mentioned] are equal to a wheel base,
A rotation phase of one impeller and an impeller of another side has shifted 90 degrees, and rotates in the direction at isogonism speed,
An agitating device whose side curved surface shape of an impeller is the form to which a point of one impeller touches a flank part of an impeller of another side mostly in a total rotary place.
[Claim 2]
An agitating device of Claim 1 with which two churning axes revolve around the sun with rotation.
[Claim 3]
An agitating device of Claim 2 longer the elliptical major-axis length of the above-mentioned impeller than one half of wheel bases and almost equal to length inscribed in a vertical mixing vessel on a line which connects between axes.
[Claim 4]
An agitating device of Claim 1 which is a field where the side of the above-mentioned impeller is linear to a lengthwise direction.
[Claim 5]
An agitating device of Claim 1 whose side of the above-mentioned impeller is a screw type-like side.

[Claim 6]
Rotation / revolution drive mechanism of an impeller of the above-mentioned couple makes a carrier of an epicyclic-gear driving mechanism provided with one pair of same planet gears support both impeller axis, enabling free rotation, An agitating device of Claim 2 which drives both impeller axis by the above-mentioned planet gear, respectively, makes a support component support the above-mentioned carrier, enabling free rotation, and coincides a center of rotation of the carrier concerned with the center of a mixing vessel positioned and fixed.
[Claim 7]
An agitating device of Claim 6 with which the above-mentioned epicyclic-gear driving mechanism makes a carrier free, and uses flywheel starter gear or a solar gear as a gear drive.
[Claim 8]
An agitating device of Claim 6 with which the above-mentioned epicyclic-gear driving mechanism uses a carrier as a driving member, and uses flywheel starter gear or a solar gear as a stationary gear.

[Claim 9]
An agitating device of Claim 6 with which a positioning mechanism of a mixing vessel to the above-mentioned impeller provides a non-circular recess in the buck upper surface, carries out fitting of the lower end of an isomorphism-like mixing vessel to the non-circular recess concerned, and fixes a mixing vessel to a buck enabling free attachment and detachment.
[Claim 10]
An agitating device of Claim 5 which means for supporting of the above-mentioned epicyclic-gear driving mechanism make a guide support support an epicyclic-gear driving mechanism, enabling free rise and fall, and is made to carry out a rise-and-fall drive according to a feed screw mechanism.
[Claim 11]
A support component is made to support a gear drive movably, enabling free rotation, and is made to support a churning axis and an intermediate shaft of a couple movably, enabling free rotation.
A pinion of a churning axis of a couple and the above-mentioned intermediate shaft is driven by the above-mentioned gear drive,
A rotating table with a gear is provided in a buck, and it is equipped with a mixing vessel at the rotating table concerned, enabling free attachment and detachment,
An agitating device of Claim 5 which drives a gear of a rotating table by a pinion of the above-mentioned intermediate shaft lower end.
[Claim 12]
An agitating device of Claim 11 which made an infinite variable-speed drive placed between the above-mentioned intermediate shafts.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application]
This invention relates to the agitating device which agitates a fluid with the comparatively high degree of viscosity.
Being able to agitate and mix the fluid of a mixing vessel efficiently uniformly, and rotating an impeller comparatively slowly about the agitating device which agitates the viscous fluid in the mixing vessel on the cylinder of every length by two impellers. Two or more high viscous fluid is with high precision and uniformly mixable in a short time.

[0002]
[Description of the Prior Art]
Not only high viscous fluid but various fluids are put into the cylindrical mixing vessel of every length, and the thing of various mechanisms is among the agitating devices which agitate this by the impeller of a vertical mold. One of them is based on a 1 axis impeller, and the example is indicated to JP,H8-71398,A. Although the form structure of the impeller in such an agitating device is various, what is depended on a spiral thin board, the thing to depend on a plate-like vertical board, etc., Both the things indicated in the above-mentioned gazette shift a phase one by one to a hand of cut, provide in multistage the tabular impeller which has a lengthwise direction churning function and a transverse direction churning function, by this, raise the churning efficiency of a sliding direction and raise the agitation performance of high viscous fluid.
Some which are indicated to JP,2002-113344,A are provided with the 2 axis impeller, for example, and this thing raises agitation efficiency by making it revolve around the sun, making the spiral impeller of two size rotate.
[0003]
Although based on what is depended on a 1 axis impeller, and a 2 axis impeller, about all, each impeller rotates within a mixing vessel independently separately, or it rotates and revolves around the sun, and this is agitated to a hand of cut or a hand of cut, and a lengthwise direction.
Although shearing force acts on the fluid with which the surface rotates to the fluid in a mixing vessel, and is in contact with the wings surface, the impeller in an agitating device, In the case of a fluid (this is called "high viscous fluid" below) with the comparatively high degree of viscosity, it does not exfoliate from the impeller surface for that adhesiveness, but, for that reason, is dragged, this drag power reaches far and wide, and it becomes what a surrounding fluid is taken about for (it corotates). There is also a layer adhering to the impeller surface. For this reason, even if churning / mixing efficiency is very bad as a whole, and the portion hardly agitated and mixed remains, churning / mixing accuracy is bad as a result and it lengthens churning time, it may be unable to agitate and mix uniformly.

[0004]
[Problem(s) to be Solved]
Then, that the portion which is not agitated about the agitating device of the high viscous fluid by a 2 axis impeller by preventing the circumference of the companion of the fluid agitated certainly, and adhering to the impeller surface generates this invention so that it can prevent certainly, Let it be the SUBJECT 1 to devise the form of the impeller of a couple.
[0005]
Let it be the SUBJECT 2 to devise the form of the impeller of a couple so that you may force the fluid in a mixing vessel into the flow in alignment with the fixed course of the turning direction and the lengthwise direction and an equal churning operation may be given to it by the impeller of a couple at the fluid in a mixing vessel.
[0006]
The impeller of a couple makes it the SUBJECT 3 to devise the drive mechanism so that a churning operation may be uniformly exerted on the fluid in a mixing vessel.
[0007]
[Means for Solving the Problem]
[Solving means 1] (It corresponds to Claim 1)
A means (solving means 1) provided in order to solve the aforementioned problem 1 makes a vertical-axis impeller of a couple rotate within a mixing vessel every length, and it is constituted by following (b) thru/or (**) on the assumption that an agitating device which agitates and mixes high viscous fluid in the above-mentioned mixing vessel.
(b) A horizontal section of an impeller centered [that it is elliptical mostly] on a vertical axis,
(**) One half of the sums of one half and minor-axis length of the major-axis length elliptical [above-mentioned] are equal to a wheel base,
(**) A rotation phase of one impeller and an impeller of another side is shifted 90 degrees, and rotates in the direction with constant angular velocity,
(**) Side curved surface shape of an impeller should be the form to which a point of one impeller touches a flank part of an impeller of another side mostly in a total rotary place.
Above "it is elliptical mostly" means what is called elliptical not but form similar to an ellipse which has a major axis and a minor axis.
The above-mentioned "high viscous fluid" means a fluid which has the degree of viscosity which is a grade in which fluid layers which adhered to an impeller and stuck on the surface of an impeller are formed.
[0008]
[Function]
Since the impeller of a couple rotates in the direction after the tip end part of one of these has touched the side of another side mostly, Since the flow (corotation) around which it takes and turns to rotation of one impeller is intercepted by the impeller of another side, it moves to the region of influence of the torque of the impeller of another side, and moves to the region of influence of the torque of the impeller which is one side again after that. Therefore, it is dragged by rotation of one impeller and the turning stream centering on the impeller concerned does not arise. A fluid to be agitated will be agitated in a mixing vessel, repeating the above movements (flow).
[0009]
After the tip end part of the impeller of another side has touched mostly to the side of one impeller, since it rotates to a counter direction mutually, the layer adhering to the side of one impeller fails to be scratched by the impeller of another side, and it is pushed aside to the churning field by the impeller of above-mentioned another side. And dropping [scratch] to each of the both side surfaces of above-mentioned one impeller is repeated at 1 time of a rate for every rotation. Therefore, the fluid which once adhered to the side of the impeller will also be certainly agitated just behind that.

Since one half of the major-axis length of the sectional shape of an impeller and one half of the sums of minor-axis length are almost equal to a wheel base, the center section of a mixing vessel will also be in the churning field by rotation of an impeller.

[0010]

[Embodiment 1] (It corresponds to Claim 2)

The embodiment 1 is making a churning axis revolve around the sun with rotation about the agitating device of the solving means 1.

[0011]

[Function]

Since the tendency around which viscous fluid takes and turns to the whole fluid in a mixing vessel as compared with the case where the equal impeller of each again rotates in the regular position in a churning operation since it revolves around the sun while the impeller of a couple rotates within a mixing vessel is small, an agitating speed improves further.

[0012]

[Embodiment 2] (It corresponds to Claim 3)

The embodiment 2 is the major-axis length elliptical [the] is longer than one half of wheel bases, and almost equal to the length inscribed in a vertical mixing vessel on the line which connects between axes about the impeller of the above-mentioned embodiment 1.

[0013]

[Function]

Since the fluid which adhered also about the inner surface of the mixing vessel since the impeller touched the inner surface of the mixing vessel repeatedly by the rotation, revolving around the sun fails to be scratched at the tip of an impeller and returned to the churning field by an impeller, the fluid which once adhered to the inner surface of the mixing vessel will also be agitated certainly. Therefore, all the portions of a mixing vessel become a churning field by rotation and revolution of an impeller, and are agitated uniformly.

[0014]

[Embodiment 3] (It corresponds to Claim 4)

The embodiment 3 is having made the side of the impeller in the above-mentioned solving means 1 into the field linear to a lengthwise direction.

[0015]

[Function]

Since the side of an impeller is a field linear to a lengthwise direction, it is agitated, while viscous fluid is pushed ahead [hand-of-cut] and extruded over a surface area by the method of the outside of a radial direction by rotation of an impeller. At this time, where line contact is mostly carried out along the straight line of a lengthwise direction to the side of the impeller of another side, it will slide on a hand of cut, and the point of one impeller will turn the viscous fluid adhering to the side of the impeller of above-mentioned another side ahead [hand-of-cut], and will rake it out. Since the side of an impeller is a field linear to a lengthwise direction, the form is comparatively simple, therefore manufacture is comparatively easy.

[0016]

[Solving means 2] (It corresponds to Claim 5)

The means (solving means 2) provided in order to solve the aforementioned problem 2 is that the side of the impeller in the above-mentioned solving means 1 is a screw type-like side.

[0017]

[Function]

Since the side of an impeller is a screw type-like side, it is agitated, while an impeller functions as a screw and it viscous fluid is not only stirred by rotation of an impeller, but is extruded by the method of the outside of a radial direction, and the slanting lower part (it is the slanting upper part depending on a hand of cut) over a surface area. Thus, since it is positively agitated by the sliding

direction while viscous fluid is stirred, in a mixing vessel, a complicated flow is produced and churning is promoted by this.
The point of one impeller is a screw type-like, is in the state which carried out line contact mostly along with the spiral of a lengthwise direction to the spiral side of the impeller of another side, will slide on a spiral direction, and the viscous fluid adhering to the side of the impeller of above-mentioned another side will be turned to the hand-of-cut front and a slanting lower part, and it will rake it out.
[0018]
Although the screw type spiral pitch of the above is arbitrary, the operation which extrudes a fluid caudad increases, so that a spiral pitch is small, and another side resistance also increases. On the other hand, the extrusion rate to a lower part falls, so that a spiral pitch is small. Since the relation between this pitch and the agitation performance of an impeller is based also on physical properties, such as revolving speed of an impeller, and the degree of viscosity of the fluid agitated, an optimum pitch is not generally decided. There is no other way but separately optimal to spiral choose [a required churning degree, churning time, etc.].
[0019]
[Solving means 3] (It corresponds to Claim 6)
The means (solving means 3) provided in order to solve the aforementioned problem 3 is having constituted the drive mechanism which makes the impeller of the couple rotate and revolve around the sun by following (b) (**) and (**) about the embodiment 1 of the above-mentioned solving means 1.
(b) The carrier of the epicyclic-gear driving mechanism provided with the same planet gear of a couple was made to support both the impeller axis, enabling free rotation,
(**) Drive both impeller axis by the above-mentioned planet gear, respectively,
(**) A support component was made to support the above-mentioned carrier, enabling free rotation, and a center of rotation of the carrier concerned was coincided with the center of a mixing vessel positioned and fixed.
[0020]
[Function]
Since the center of rotation of the carrier of an epicyclic-gear driving mechanism is in agreement with the center of a mixing vessel, while two impellers serve as a pair and rotate at uniform velocity in the direction, along with the concentric circle to a mixing vessel, it revolves around the sun. Therefore, the fluid in a mixing vessel is uniformly agitated uniformly [the churning operation by the impeller of a couple] in the fluid in a mixing vessel.
[0021]
[Embodiment 1] (It corresponds to Claim 7)
The embodiment 1 is having made the carrier free and having used flywheel starter gear or a solar gear as the gear drive about the epicyclic-gear driving mechanism of the above-mentioned solving means 3.
[0022]
[Embodiment 2] (It corresponds to Claim 8)
The embodiment 2 is having used the carrier as the driving member and having used flywheel starter gear or a solar gear as the stationary gear about the epicyclic-gear driving mechanism of the above-mentioned solving means 3.
[0023]
[Embodiment 3] (It corresponds to Claim 9)
The embodiment 3 is having provided the non-circular recess in the buck upper surface, having carried out fitting of the lower end of an isomorphism-like mixing vessel to the non-circular recess concerned, and having fixed the mixing vessel to the above-mentioned buck about the positioning mechanism of the mixing vessel to the impeller in the above-mentioned solving means 3, enabling

free attachment and detachment.
[0024]
[Function]
By fixing the means for supporting and the above-mentioned buck of an epicyclic-gear gearing, where the center of rotation of an epicyclic-gear gearing and the center of the non-circular recess on the upper surface of a buck are coincided. Since the center of the non-circular recess on the upper surface of a buck and the center of rotation of an epicyclic-gear gearing are in agreement, the center of rotation of an epicyclic-gear gearing and the center of a mixing vessel are always in agreement by carrying out fitting of the lower end of an isomorphism-like mixing vessel to the non-circular recess on the upper surface of a buck.
Therefore, attachment of the mixing vessel at the time of a maintenance can be made simply and easy.
[0025]
[Embodiment 4] (It corresponds to Claim 10)
The embodiment 4 is making an epicyclic-gear driving mechanism support by a guide support, enabling free rise and fall, and having been made to carry out a rise-and-fall drive according to a feed screw mechanism about the means for supporting of the epicyclic-gear driving mechanism in the above-mentioned embodiment 3.
[0026]
[Function]
By raising the above-mentioned base material by the above-mentioned feed screw mechanism, by being able to pull up an impeller with an epicyclic-gear driving mechanism, and being able to take out from a mixing vessel to the upper part, and making it descend, an impeller can be depressed and it can insert in a mixing vessel from the upper part with an epicyclic-gear driving mechanism. Since between the detaching operation to the mixing vessel of this impeller is maintained by a guide support, as for the physical relationship of an impeller and a mixing vessel, it does not need to perform positioning of an impeller and a mixing vessel at the time of re mounting.
[0027]
[Solving means 4] (It corresponds to Claim 11)
Other means (solving means 4) provided in order to solve the aforementioned problem 3 are having constituted the drive mechanism of the agitating device by the above-mentioned solving means 2 by following (b) thru/or (**).
(b) The support component was made to support a gear drive movably, enabling free rotation, and was made to support the churning axis and intermediate shaft of a couple movably, enabling free rotation,
(**) Provide a rotating table with the gear in a (**) buck, and equip [driving the pinion of the churning axis of a couple, and the above-mentioned intermediate shaft by the above-mentioned gear drive,] it with a mixing vessel at the rotating table concerned, enabling free attachment and detachment,
(**) Drive the gear of a rotating table by the pinion of the above-mentioned intermediate shaft lower end.
[0028]
[Function]
The churning axis of a couple is driven at uniform velocity in the direction by the above-mentioned gear drive. On the other hand, since a rotating table is driven by the above-mentioned gear drive via an intermediate shaft, it is driven to a counter direction with a churning axis. Therefore, a mixing vessel drives to a counter direction with an impeller.
And since the viscous fluid in it circles to a counter direction with an impeller by rotation of a mixing vessel, a stirring effect and an agitating speed improve notably uniformly [the stirring effect by an impeller] to the viscous fluid in a mixing vessel.

[0029]
[Embodiment 1] (It corresponds to Claim 12)
The embodiment 1 is having made the infinite variable-speed drive placed between the above-mentioned intermediate shafts about the drive mechanism of the solving means 4.
[0030]
[Function]
Since the above-mentioned rotating table drives by the above-mentioned gear drive via the infinite variable-speed drive of an intermediate shaft, the revolving speed of a rotating table is stepless and is adjusted.
Since a churning operation of the agitating device by the solving means 4 is adjusted with the rotating velocity of an impeller, and the revolving speed of a mixing vessel, it can adjust a churning operation suitably according to the kind of fluid to be agitated, the churning purpose, churning lapsed time, etc. by adjusting the revolving speed of a rotating table with an infinite variable-speed drive.
Since the hand of cut of a rotating table is reversed and the revolving speed can be adjusted if it is made the gearbox which can reverse the above-mentioned infinite variable-speed drive, it is still wide range and the strength of a churning operation can be adjusted with the roll control of a rotating table.
[0031]
[Embodiment of the Invention]
[Work example 1]
Sag of the two axes 2 and 2 is carried out by the wheel base L from the epicyclic-gear gearing, and the impeller 1 is attached to the axes 2 and 2 of this couple, respectively. These impellers 1 and 1 are fields where that side is linear to a lengthwise direction.
It is mutually turned in the right-angled direction, and the axes 2 and 2 rotate in the direction at uniform velocity.

The major axis 1a of the impeller 1 of this example is 71 mm, and the minor axis 1b is 35 mm. And although the curved surface shape of the side of an impeller can be chosen suitably, when both the impellers 1 and 1 rotate, in a total rotary place, the major-axis end of one impeller has a relation which touches the side of the impeller of another side mostly.
[0032]
Namely, when it is as an example of the form of the impeller 1 and the plane shape of the two impellers 1 and 1 being shown in drawing 14 (a) and two impellers in this thing have a right-angled relation mutually, When distance between the axes of rotation of two impellers is set to L, the curvature radius of the impeller side curved surface is set to R and the major-axis end circle radius of an impeller is set to alpha, It is L=R+alpha, R=L-alpha, and alpha=L-R, and when distance of the center of the curvature radius R of the impeller side curved surface and an impeller shaft center is set to C, it can compute by C=root2 (L/2-alpha). If the inside diameter of the mixing vessel at this time is set to D, it will be set to D=2(C+alpha)+L, and that center will serve as the middle point between the two axes of rotation.
Drawing 14 (b) sets the wheel base L to 50, is an example when the major-axis end circle radius alpha is set to 3, and is set to R=50-3=47, C=root2(50 / 2-3)=31.113, and D=2(31.113+3) +50=118.226.
Drawing 14 (c) sets the wheel base L to 50, shows plane shape in case the major-axis end which set the major-axis end circle radius alpha to 0 is edge shape, and is set to R=50-0=50 in this case, C=root2(50 / 2-0)=35.355, and D=2(35.355+0)+50=120.71.
[0033]
Although the viscous fluid in the mixing vessel 3 is agitated by the impellers 1 and 1 of the above-mentioned couple, the inside diameter A of the mixing vessel 2 in this example is 124 mm, and the depth is 55 mm.

Relative rotating of the impeller of a couple is carried out in the direction in the mode of drawing 3 (a), (b), and (c). It slides so that the above-mentioned side may be ground, after the tip end part of one impeller 1 contacted mostly and has contacted in the lengthwise direction straight line to the side of the impeller 1 of another side at this time. Therefore, the flow of viscous fluid around which it takes and turns to the arrow direction of drawing 3 with one impeller will be severed by the impeller of another side, and will be pushed back in the direction contrary to the flow. The viscous fluid adhering to the flank part of the impeller of another side fails to be scratched by the point of one impeller. And the side which it fails to scratch of the two impellers so that change of drawing 3 (a), (b), and (c) may show, Since the side in which the side which fails to be scratched takes the place one by one by rotation, and one impeller fails to be scratched is also changed one by one by rotation of an impeller, the viscous fluid adhering to the both side surfaces of two impellers will fail to be scratched intermittently.
Since the major-axis end of the impeller 1 of this example slides on the inner surface of the mixing vessel 3 intermittently and the impellers 1 and 1 revolve around the sun within a mixing vessel, the viscous fluid adhering to the inner surface of the mixing vessel also fails to be intermittently scratched by the tip of an impeller.
[0034]
Only 50 cc (viscous degree 80 Pa-s), feed 100 cc (viscous degree 100 Pa-s) and the ink for lithography (yellow) into the mixing vessel 3, and the ink for lithography (cyanogen) under 25 ** temperature, By 76 rotating velocity/of an impeller, when [20 revolution speed] agitating by a part for /, as compared with the case (the conditions) where it is based on the conventional agitating device, the churning time is mostly shortened to 1/10.
Although churning unevenness is not avoided in conventional technology, churning unevenness is completely solved in this example.
[0035]
Next, the rising and falling mechanism of the impeller drive by the epicyclic-gear gearing of this embodiment and an agitating device, etc. are explained.
Impeller drives are epicyclic-gear dynamo-electric means of the form which the flywheel starter gear 4 are being fixed to the support plate 14, and the carrier of a planet gear drives with an electric motor.
The support plate 14 is guided by the two guide supports 21 and 21, enabling free rise and fall. The vertical screw-thread axis 23 is among the guide supports 21 and 21, the lower end is supported by the buck 20 by a bearing, enabling free rotation, and the upper part is supported by the bearing by the side between the guide supports 21 and 21, enabling free rotation. And **** on the screw-thread axis 23, the sleeve 22 is made to have screwed, and this screw-thread sleeve 22 is being fixed to the support plate 14.
The flywheel starter gear 4 are being fixed to the undersurface of the support plate 14 with the screw 14a, and an upper bed of the cylindrical carrier 9 is supported by these flywheel starter gear 4 via the bearing 10.
The carrier 9 is held via the bearing 10 at the flywheel starter gear 4, enabling free rotation.
The two vertical axes 2 and 2 are supported by this carrier 9 via the bearings 8 and 8, enabling free rotation.

The driving shaft 15 was inserted in a center hole of the carrier 9, it has adhered, and the upper bed is connected with an axis of the electric motor 18 via the coupling 17, enabling free attachment and detachment.
[0036]
The planet gears 5 and 5 have adhered to an upper bed of the vertical axes 2 and 2, respectively, and these planet gears 5 and 5 have geared to the above-mentioned flywheel starter gear 4. The vertical axes 2 and 2 are caudad prolonged from a lower end of the carrier 9, and the lower end is

inserted in a center hole of the above-mentioned impellers 1 and 1. In this example, the impeller electrode holder 7 has adhered to an upper bed side of the impeller 1, and this impeller electrode holder 7 has adhered to the vertical axes 2 and 2 by a pin, enabling free attachment and detachment.
As mentioned above, since the vertical axes 2 and 2 are held via the bearings 8 and 8 at the carrier 9, the carrier 9 is held via the bearing 10 at the flywheel starter gear 4, the flywheel starter gear 4 **** and it is being fixed to the support plate 14 by 14a, If the screw-thread axis 23 is rotated by the handle 24 and you make it go up and down the support plate 14, a drive will go up and down with this, and an impeller will go up and down. By raising an impeller, when the impeller 1 escapes to the upper part and drops it from the mixing vessel 3, the impeller 1 is inserted into the mixing vessel 3.
[0037]
The mixing vessel 3 is a cylindrical body, that lower end has the flange 3a, and the flat-surface part 3b of the couple which opposes this flange 3a is formed. On the other hand, the upper surface of the buck 20 has a crevice of form into which the flange 3a of the mixing vessel 3 gets densely, the above-mentioned flange will get into this crevice, and the mixing vessel 3 will be held at the buck 20 at rotation impossible.
[0038]
The driving shaft 15 drives via the coupling 17 with the axis of an electric motor, the carrier 9 drives by this, and the revolution drive of the vertical axes 2 and 2 is carried out by rotation of the carrier 9. Since the planet gear which has adhered to the upper bed of the vertical axes 2 and 2 has geared to the flywheel starter gear 4, while the vertical axes 2 and 2 rotate, it will revolve around the sun. And the two above-mentioned planet gears are the same, and since it has geared to the same flywheel starter gear 4, the revolving speed of both the vertical axes 2 and 2 is equal, and revolves the same orbit top around the sun.
[0039]
[Work example 2]
Subsequently, the example of the agitating device by the solving means 2 is explained.
This Embodiment 2 does not have a difference in particular with the above-mentioned Embodiment 1 except for the point that the side of an impeller is a screw type-like side. The upper bed side of the impeller of this thing is in the position which shifted to the hand of cut 90 degrees to the lower end surface, and the side in the meantime and end rim are a screw type.
The plane shape of this thing and side form are as being shown in drawing 9 (a) and (b), and the section A-A in drawing 9 (b), B-B, C-C, D-D, and E-E are as being shown in drawing 10 (A) - (E), respectively.
All of such sectional shape are the same.

The elliptical (not the thing that says a strict ellipse but form which resembled the ellipse mostly) outline of the end face of the impeller 31 of this example, It is the form drawn by major axis of 71 mm, and 35 mm of minor axes with the common inscribed circle arc z and the partial circle of the above-mentioned imaginary circle x to the imaginary circle x with a radius of 4.77 mm of major-axis both ends, and the imaginary circle y with a main radius of 17.5 mm. The height of this impeller 31 is 50 mm. The overview of this thing is as being shown in drawing 11.
[0040]
By the same appearance as the case where two screws (screw-thread stick) gear mutually, the two impellers 31 and 31 are put together mutually, are arranged, and rotate at uniform velocity in the direction like Embodiment 1. A fluid is agitated at this time, the impeller 31 spiral-like side extruding at the method of the outside of a radial direction, and a slanting lower part (or slanting upper part). And since it exercises for a counter direction mutually while a major axis direction end spiral to one impeller slides on the spiral side of the impeller of another side mutually in the state where it contacted mostly, it is failed to scratch the viscous fluid adhering to the spiral side of the impeller of

above-mentioned another side at the major axis direction end of above-mentioned one impeller. Since the impeller 31 extrudes in a direction with the velocity component of a turning direction, and the velocity component of the lengthwise direction strongly and a complicated flow is generated between the mixing vessel 3 and the impellers 31 and 31, the viscous fluid in the mixing vessel 3 has a very high stirring effect. Therefore, what is called a Weissenberg effect generated when the degree of viscosity mixes a greatly different substance (a unique flow phenomenon: if a stick is thrust in and stirred in a solution, an oil level will be cratered in a Newton liquid, but.) In a non-Newtonian liquid, the phenomenon which goes up by carrying out can be controlled so that it may rise conversely and may coil around a stick, and even when the degree of viscosity mixes a greatly different substance, churning and mixing are made very efficiently.

[0041]

As for the impellers 31 and 31 of the agitating device shown in drawing 7 and drawing 8, it is needless to say that it drives with the drive by the epicyclic-gear driving mechanism shown in drawing 4 thru/or drawing 6, both impellers are made to rotate and revolve around the sun, and the viscous fluid in the mixing vessel 3 can be agitated. However, as for the screw type-like two impellers 31 and 31, since the churning operation is powerful, a stirring effect is enough demonstrated only by rotation. Therefore, viscous fluid can fully be agitated only by rotation of the impellers 31 and 31 in a short time.

A churning drive only by rotation of the impellers 31 and 31 is shown in drawing 12. This thing is supported by the support plate 42 currently supported by the guide supports 41 and 41 enabling free rise and fall, enabling free rotation of the gear drive 43.

A vertical axis of the impellers 31 and 31 is supported enabling free rotation.

The pinion 44 has adhered to this vertical axis, respectively, and the pinion concerned has geared with the gear drive 43.

Since the pinion 44 will drive at uniform velocity in the direction if the driving shaft 45 of the gear drive 43 is driven with an electric motor, the impellers 31 and 31 drive at uniform velocity in the direction.

[0042]

An example of other drives is explained with reference to drawing 13. This drive also drives the mixing vessel 3 simultaneously with an impeller to an example of drawing 12 driving the impellers 31 and 31. In the pinion 44, an opposite hand is made to have supported the intermediate shaft 51, enabling free rotation to the support plate 42, and the pinion 52 which adhered to an upper bed of this intermediate shaft is engaged to the gear drive 43. On the other hand, the buck 60 is made to have supported the rotating table 61, enabling free rotation, and this rotating table 61 is made to attach the mixing vessel 3 like Embodiment 1, enabling free attachment and detachment. And the gear 61a is formed in a peripheral face of the rotating table 61, and the pinion 53 which adhered to the gear 61a concerned in a lower end of the intermediate shaft 51 has geared.

Therefore, the rotating table 61 drives to the impeller 3 and a counter direction via the intermediate shaft 51 and the pinions 52 and 53 by the gear drive 43, therefore the mixing vessel 3 drives to the impeller 3 and a counter direction.

[0043]

Since high viscous fluid corotates to an arrow direction and the impeller 31 rotates to a counter direction with this by rotation of the mixing vessel 3, a stirring effect improves further. Since a stirring effect changes by adjusting revolving speed of an impeller, and revolving speed of the mixing vessel 3, A stirring effect can be minutely adjusted to the intermediate shaft 51 according to character of a fluid in the mixing vessel 3, and the churning purpose by making an easy infinite variable-speed drive by friction roller, a V belt, etc. intervene, and adjusting revolving speed of the mixing vessel 3 by this.

[0044]

[Effect of the Invention]

It will be as follows if this effect of the invention is arranged.
1. The 1st effect of the invention
Invention (invention concerning Claim 1) by the solving means 1, By the impeller of a couple rotating in the direction, and rotating, rubbing each other, after the major-axis end of one impeller has contacted the side of the impeller of another side mostly, The flow of the fluid which takes and corotates to rotation of each impeller is intercepted by the impeller of another side, corotation is prevented, and it pushes back in the direction with the opposite corotation direction concerned. Thus, the pushed-back fluid moves to the churning field of the impeller of above-mentioned another side, and is agitated by this. It is failed at the major-axis end of above-mentioned one impeller to scratch the layer of the fluid adhering to the side of the impeller of above-mentioned another side, is derived to the churning field of one impeller, and is agitated by this.
Therefore, the fluid in a mixing vessel is agitated uniformly.
[0045]
2. The 2nd effect of the invention
Invention (invention concerning Claim 5) by the solving means 2, By the side of an impeller being a spiral surface and the impeller of a couple rotating in the direction, and rotating, rubbing each other, after the major-axis end of one impeller has contacted the side of the impeller of another side mostly, The flow of the fluid which takes and corotates to rotation of each impeller is intercepted by the impeller of another side, corotation is prevented, and it pushes back in the direction with the opposite corotation direction concerned.
Since horizontal section form is elliptical mostly and the side is a spiral form, since the rotation extrudes in the lower part (it is the upper part depending on a hand of cut) of a fluid strongly, the strong flow of a sliding direction is produced in viscous fluid by it.
Since viscous fluid flows in a complicated course by churning accompanying rotation, and churning by the flow of a sliding direction, changing a direction, churning is promoted further.
[0046]
3. The 3rd effect of the invention
Since invention (invention concerning Claim 6) by the solving means 3 drives the churning impeller of a couple with an epicyclic-gear gear and makes this rotate and revolve around the sun, it can rotate the impeller of a couple at uniform velocity with easy drive mechanism, and can be made to revolve around the sun on the orbit. Therefore, the manufacturing cost of drive mechanism can be reduced and the small weight saving of a drive is attained.
[0047]
4. The 4th effect of the invention
Invention (invention concerning Claim 11) by the solving means 4, Since a mixing vessel is rotated while making an impeller rotate, it compares with what produces a stirring effect only in rotation of an impeller, Although a stirring effect is remarkably high, and the rotary drive of a mixing vessel is made into rotation and the thing of form made to revolve around the sun since it is very simple, and agitation performance is not exceptionally different, a drive can be simplified remarkable.
Agitation performance can be suitably adjusted by adjusting the revolving speed of a mixing vessel, with the revolving speed of an impeller fixed.
[Brief Description of the Drawings]
[Drawing 1]The top view of the important section of ******** 1.
[Drawing 2]The perspective view of the important section of ******** 1.
[Drawing 3]The top view showing the operating state of ******** 1.
[Drawing 4]The important section top view of the impeller drive of ******** 1.
[Drawing 5]Drawing of longitudinal section of ******** 1.
[Drawing 6]Drawing of longitudinal section of the important section of the impeller drive of ********
1.
[Drawing 7]The top view of the important section of ******** 2.

[Drawing 8]The perspective view of the important section of ******** 2.
[Drawing 9](a) is a top view of the impeller of Embodiment 2, and (b) is a side view of the impeller.
[Drawing 10](A) - (E) is a section A-A in Fig. 9 (b) - a sectional view of E-E.
[Drawing 11]The whole impeller outline view of ******** 2.
[Drawing 12]The perspective view of Embodiment 2 showing an example of a ****** drive.
[Drawing 13]The perspective view of Embodiment 2 showing other examples of **********.
[Drawing 14](a) and (b) are the top views for explaining an example of the plane shape of the impeller in an embodiment.
(b) is a top view for explaining other examples of plane shape, and (c) is a top view for explaining the example of further others.

[Explanations of letters or numerals]
1: Impeller
2: Vertical axis
3: Mixing vessel
4: Flywheel starter gear
5: Planet gear
7: Impeller electrode holder
8: Bearing
9: Carrier
10: Bearing
14: Support plate
15: Driving shaft
17: Coupling
20: Buck
21: Guide support
23: Screw-thread axis
31: Impeller
41: Guide support
42: Support plate
43: Gear drive
44: Pinion
45: Driving shaft
51: Intermediate shaft
52, 53: Pinion
60: Buck
61: Rotating table
61a: Gear

[Translation done.]

* NOTICES *

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TECHNICAL FIELD

[Industrial Application]
This invention relates to the agitating device which agitates a fluid with the comparatively high degree of viscosity.
Being able to agitate and mix the fluid of a mixing vessel efficiently uniformly, and rotating an impeller comparatively slowly about the agitating device which agitates the viscous fluid in the mixing vessel on the cylinder of every length by two impellers. Two or more high viscous fluid is with high precision and uniformly mixable in a short time.

[0002]

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PRIOR ART

[Description of the Prior Art]
Not only high viscous fluid but various fluids are put into the cylindrical mixing vessel of every length, and the thing of various mechanisms is among the agitating devices which agitate this by the impeller of a vertical mold. One of them is based on a 1 axis impeller, and the example is indicated to JP,H8-71398,A. Although the form structure of the impeller in such an agitating device is various, what is depended on a spiral thin board, the thing to depend on a plate-like vertical board, etc., Both the things indicated in the above-mentioned gazette shift a phase one by one to a hand of cut, provide in multistage the tabular impeller which has a lengthwise direction churning function and a transverse direction churning function, by this, raise the churning efficiency of a sliding direction and raise the agitation performance of high viscous fluid.
Some which are indicated to JP,2002-113344,A are provided with the 2 axis impeller, for example, and this thing raises agitation efficiency by making it revolve around the sun, making the spiral impeller of two size rotate.
[0003]
Although based on what is depended on a 1 axis impeller, and a 2 axis impeller, about all, each impeller rotates within a mixing vessel independently separately, or it rotates and revolves around the sun, and this is agitated to a hand of cut or a hand of cut, and a lengthwise direction.
Although shearing force acts on the fluid with which the surface rotates to the fluid in a mixing vessel, and is in contact with the wings surface, the impeller in an agitating device, In the case of a fluid (this is called "high viscous fluid" below) with the comparatively high degree of viscosity, it does not exfoliate from the impeller surface for that adhesiveness, but, for that reason, is dragged, this drag power reaches far and wide, and it becomes what a surrounding fluid is taken about for (it corotates). There is also a layer adhering to the impeller surface. For this reason, even if churning / mixing efficiency is very bad as a whole, and the portion hardly agitated and mixed remains, churning / mixing accuracy is bad as a result and it lengthens churning time, it may be unable to agitate and mix uniformly.
[0004]

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EFFECT OF THE INVENTION

[Effect of the Invention]
It will be as follows if this effect of the invention is arranged.
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Invention (invention concerning Claim 1) by the solving means 1, By the impeller of a couple rotating in the direction, and rotating, rubbing each other, after the major-axis end of one impeller has contacted the side of the impeller of another side mostly, The flow of the fluid which takes and corotates to rotation of each impeller is intercepted by the impeller of another side, corotation is prevented, and it pushes back in the direction with the opposite corotation direction concerned. Thus, the pushed-back fluid moves to the churning field of the impeller of above-mentioned another side, and is agitated by this. It is failed at the major-axis end of above-mentioned one impeller to scratch the layer of the fluid adhering to the side of the impeller of above-mentioned another side, is derived to the churning field of one impeller, and is agitated by this.
Therefore, the fluid in a mixing vessel is agitated uniformly.
[0045]
2. The 2nd effect of the invention
Invention (invention concerning Claim 5) by the solving means 2, By the side of an impeller being a spiral surface and the impeller of a couple rotating in the direction, and rotating, rubbing each other, after the major-axis end of one impeller has contacted the side of the impeller of another side mostly, The flow of the fluid which takes and corotates to rotation of each impeller is intercepted by the impeller of another side, corotation is prevented, and it pushes back in the direction with the opposite corotation direction concerned.
Since horizontal section form is elliptical mostly and the side is a spiral form, since the rotation extrudes in the lower part (it is the upper part depending on a hand of cut) of a fluid strongly, the strong flow of a sliding direction is produced in viscous fluid by it.
Since viscous fluid flows in a complicated course by churning accompanying rotation, and churning by the flow of a sliding direction, changing a direction, churning is promoted further.
[0046]
3. The 3rd effect of the invention
Since invention (invention concerning Claim 6) by the solving means 3 drives the churning impeller of a couple with an epicyclic-gear gear and makes this rotate and revolve around the sun, it can rotate the impeller of a couple at uniform velocity with easy drive mechanism, and can be made to revolve around the sun on the orbit. Therefore, the manufacturing cost of drive mechanism can be reduced and the small weight saving of a drive is attained.
[0047]
4. The 4th effect of the invention
Invention (invention concerning Claim 11) by the solving means 4, Since a mixing vessel is rotated while making an impeller rotate, it compares with what produces a stirring effect only in rotation of

an impeller, Although a stirring effect is remarkably high, and the rotary drive of a mixing vessel is made into rotation and the thing of form made to revolve around the sun since it is very simple, and agitation performance is not exceptionally different, a drive can be simplified remarkable.
Agitation performance can be suitably adjusted by adjusting the revolving speed of a mixing vessel, with the revolving speed of an impeller fixed.

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TECHNICAL PROBLEM

[Problem(s) to be Solved]
Then, that the portion which is not agitated about the agitating device of the high viscous fluid by a 2 axis impeller by preventing the circumference of the companion of the fluid agitated certainly, and adhering to the impeller surface generates this invention so that it can prevent certainly, Let it be the SUBJECT 1 to devise the form of the impeller of a couple.
[0005]
Let it be the SUBJECT 2 to devise the form of the impeller of a couple so that you may force the fluid in a mixing vessel into the flow in alignment with the fixed course of the turning direction and the lengthwise direction and an equal churning operation may be given to it by the impeller of a couple at the fluid in a mixing vessel.
[0006]
The impeller of a couple makes it the SUBJECT 3 to devise the drive mechanism so that a churning operation may be uniformly exerted on the fluid in a mixing vessel.
[0007]

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MEANS

[Means for Solving the Problem]
[Solving means 1] (It corresponds to Claim 1)
A means (solving means 1) provided in order to solve the aforementioned problem 1 makes a vertical-axis impeller of a couple rotate within a mixing vessel every length, and it is constituted by following (b) thru/or (**) on the assumption that an agitating device which agitates and mixes high viscous fluid in the above-mentioned mixing vessel.
(b) A horizontal section of an impeller centered [that it is elliptical mostly] on a vertical axis,
(**) One half of the sums of one half and minor-axis length of the major-axis length elliptical [above-mentioned] are equal to a wheel base,
(**) A rotation phase of one impeller and an impeller of another side is shifted 90 degrees, and rotates in the direction with constant angular velocity,
(**) Side curved surface shape of an impeller should be the form to which a point of one impeller touches a flank part of an impeller of another side mostly in a total rotary place.
Above "it is elliptical mostly" means what is called elliptical not but form similar to an ellipse which has a major axis and a minor axis.
The above-mentioned "high viscous fluid" means a fluid which has the degree of viscosity which is a grade in which fluid layers which adhered to an impeller and stuck on the surface of an impeller are formed.
[0008]

[Translation done.]

* NOTICES *

OPERATION

[Function]
Since the impeller of a couple rotates in the direction after the tip end part of one of these has touched the side of another side mostly, Since the flow (corotation) around which it takes and turns to rotation of one impeller is intercepted by the impeller of another side, it moves to the region of influence of the torque of the impeller of another side, and moves to the region of influence of the torque of the impeller which is one side again after that. Therefore, it is dragged by rotation of one impeller and the turning stream centering on the impeller concerned does not arise. A fluid to be agitated will be agitated in a mixing vessel, repeating the above movements (flow).
[0009]
After the tip end part of the impeller of another side has touched mostly to the side of one impeller, since it rotates to a counter direction mutually, the layer adhering to the side of one impeller fails to be scratched by the impeller of another side, and it is pushed aside to the churning field by the impeller of above-mentioned another side. And dropping [scratch] to each of the both side surfaces of above-mentioned one impeller is repeated at 1 time of a rate for every rotation. Therefore, the fluid which once adhered to the side of the impeller will also be certainly agitated just behind that.
Since one half of the major-axis length of the sectional shape of an impeller and one half of the sums of minor-axis length are almost equal to a wheel base, the center section of a mixing vessel will also be in the churning field by rotation of an impeller.
[0010]
[Embodiment 1] (It corresponds to Claim 2)
The embodiment 1 is making a churning axis revolve around the sun with rotation about the agitating device of the solving means 1.
[0011]
[Function]
Since the tendency around which viscous fluid takes and turns to the whole fluid in a mixing vessel as compared with the case where the equal impeller of each again rotates in the regular position in a churning operation since it revolves around the sun while the impeller of a couple rotates within a mixing vessel is small, an agitating speed improves further.
[0012]
[Embodiment 2] (It corresponds to Claim 3)
The embodiment 2 is the major-axis length elliptical [the] is longer than one half of wheel bases, and almost equal to the length inscribed in a vertical mixing vessel on the line which connects between axes about the impeller of the above-mentioned embodiment 1.
[0013]
[Function]
Since the fluid which adhered also about the inner surface of the mixing vessel since the impeller

touched the inner surface of the mixing vessel repeatedly by the rotation, revolving around the sun fails to be scratched at the tip of an impeller and returned to the churning field by an impeller, the fluid which once adhered to the inner surface of the mixing vessel will also be agitated certainly. Therefore, all the portions of a mixing vessel become a churning field by rotation and revolution of an impeller, and are agitated uniformly.

[0014]

[Embodiment 3] (It corresponds to Claim 4)

The embodiment 3 is having made the side of the impeller in the above-mentioned solving means 1 into the field linear to a lengthwise direction.

[0015]

[Function]

Since the side of an impeller is a field linear to a lengthwise direction, it is agitated, while viscous fluid is pushed ahead [hand-of-cut] and extruded over a surface area by the method of the outside of a radial direction by rotation of an impeller. At this time, where line contact is mostly carried out along the straight line of a lengthwise direction to the side of the impeller of another side, it will slide on a hand of cut, and the point of one impeller will turn the viscous fluid adhering to the side of the impeller of above-mentioned another side ahead [hand-of-cut], and will rake it out. Since the side of an impeller is a field linear to a lengthwise direction, the form is comparatively simple, therefore manufacture is comparatively easy.

[0016]

[Solving means 2] (It corresponds to Claim 5)

The means (solving means 2) provided in order to solve the aforementioned problem 2 is that the side of the impeller in the above-mentioned solving means 1 is a screw type-like side.

[0017]

[Function]

Since the side of an impeller is a screw type-like side, it is agitated, while an impeller functions as a screw and it viscous fluid is not only stirred by rotation of an impeller, but is extruded by the method of the outside of a radial direction, and the slanting lower part (it is the slanting upper part depending on a hand of cut) over a surface area. Thus, since it is positively agitated by the sliding direction while viscous fluid is stirred, in a mixing vessel, a complicated flow is produced and churning is promoted by this.

The point of one impeller is a screw type-like, is in the state which carried out line contact mostly along with the spiral of a lengthwise direction to the spiral side of the impeller of another side, will slide on a spiral direction, and the viscous fluid adhering to the side of the impeller of above-mentioned another side will be turned to the hand-of-cut front and a slanting lower part, and it will rake it out.

[0018]

Although the screw type spiral pitch of the above is arbitrary, the operation which extrudes a fluid caudad increases, so that a spiral pitch is small, and another side resistance also increases. On the other hand, the extrusion rate to a lower part falls, so that a spiral pitch is small. Since the relation between this pitch and the agitation performance of an impeller is based also on physical properties, such as revolving speed of an impeller, and the degree of viscosity of the fluid agitated, an optimum pitch is not generally decided. There is no other way but separately optimal to spiral choose [a required churning degree, churning time, etc.].

[0019]

[Solving means 3] (It corresponds to Claim 6)

The means (solving means 3) provided in order to solve the aforementioned problem 3 is having constituted the drive mechanism which makes the impeller of the couple rotate and revolve around the sun by following (b) (**) and (**) about the embodiment 1 of the above-mentioned solving means 1.

(b) The carrier of the epicyclic-gear driving mechanism provided with the same planet gear of a couple was made to support both the impeller axis, enabling free rotation,
(**) Drive both impeller axis by the above-mentioned planet gear, respectively,
(**) A support component was made to support the above-mentioned carrier, enabling free rotation, and a center of rotation of the carrier concerned was coincided with the center of a mixing vessel positioned and fixed.
[0020]
[Function]
Since the center of rotation of the carrier of an epicyclic-gear driving mechanism is in agreement with the center of a mixing vessel, while two impellers serve as a pair and rotate at uniform velocity in the direction, along with the concentric circle to a mixing vessel, it revolves around the sun. Therefore, the fluid in a mixing vessel is uniformly agitated uniformly [the churning operation by the impeller of a couple] in the fluid in a mixing vessel.
[0021]
[Embodiment 1] (It corresponds to Claim 7)
The embodiment 1 is having made the carrier free and having used flywheel starter gear or a solar gear as the gear drive about the epicyclic-gear driving mechanism of the above-mentioned solving means 3.
[0022]
[Embodiment 2] (It corresponds to Claim 8)
The embodiment 2 is having used the carrier as the driving member and having used flywheel starter gear or a solar gear as the stationary gear about the epicyclic-gear driving mechanism of the above-mentioned solving means 3.
[0023]
[Embodiment 3] (It corresponds to Claim 9)
The embodiment 3 is having provided the non-circular recess in the buck upper surface, having carried out fitting of the lower end of an isomorphism-like mixing vessel to the non-circular recess concerned, and having fixed the mixing vessel to the above-mentioned buck about the positioning mechanism of the mixing vessel to the impeller in the above-mentioned solving means 3, enabling free attachment and detachment.
[0024]
[Function]
By fixing the means for supporting and the above-mentioned buck of an epicyclic-gear gearing, where the center of rotation of an epicyclic-gear gearing and the center of the non-circular recess on the upper surface of a buck are coincided. Since the center of the non-circular recess on the upper surface of a buck and the center of rotation of an epicyclic-gear gearing are in agreement, the center of rotation of an epicyclic-gear gearing and the center of a mixing vessel are always in agreement by carrying out fitting of the lower end of an isomorphism-like mixing vessel to the non-circular recess on the upper surface of a buck.
Therefore, attachment of the mixing vessel at the time of a maintenance can be made simply and easy.
[0025]
[Embodiment 4] (It corresponds to Claim 10)
The embodiment 4 is making an epicyclic-gear driving mechanism support by a guide support, enabling free rise and fall, and having been made to carry out a rise-and-fall drive according to a feed screw mechanism about the means for supporting of the epicyclic-gear driving mechanism in the above-mentioned embodiment 3.
[0026]
[Function]
By raising the above-mentioned base material by the above-mentioned feed screw mechanism, by

being able to pull up an impeller with an epicyclic-gear driving mechanism, and being able to take out from a mixing vessel to the upper part, and making it descend, an impeller can be depressed and it can insert in a mixing vessel from the upper part with an epicyclic-gear driving mechanism. Since between the detaching operation to the mixing vessel of this impeller is maintained by a guide support, as for the physical relationship of an impeller and a mixing vessel, it does not need to perform positioning of an impeller and a mixing vessel at the time of re mounting.

[0027]

[Solving means 4] (It corresponds to Claim 11)

Other means (solving means 4) provided in order to solve the aforementioned problem 3 are having constituted the drive mechanism of the agitating device by the above-mentioned solving means 2 by following (b) thru/or (**).

(b) The support component was made to support a gear drive movably, enabling free rotation, and was made to support the churning axis and intermediate shaft of a couple movably, enabling free rotation,

(**) Provide a rotating table with the gear in a (**) buck, and equip [driving the pinion of the churning axis of a couple, and the above-mentioned intermediate shaft by the above-mentioned gear drive,] it with a mixing vessel at the rotating table concerned, enabling free attachment and detachment,

(**) Drive the gear of a rotating table by the pinion of the above-mentioned intermediate shaft lower end.

[0028]

[Function]

The churning axis of a couple is driven at uniform velocity in the direction by the above-mentioned gear drive. On the other hand, since a rotating table is driven by the above-mentioned gear drive via an intermediate shaft, it is driven to a counter direction with a churning axis. Therefore, a mixing vessel drives to a counter direction with an impeller.

And since the viscous fluid in it circles to a counter direction with an impeller by rotation of a mixing vessel, a stirring effect and an agitating speed improve notably uniformly [the stirring effect by an impeller] to the viscous fluid in a mixing vessel.

[0029]

[Embodiment 1] (It corresponds to Claim 12)

The embodiment 1 is having made the infinite variable-speed drive placed between the above-mentioned intermediate shafts about the drive mechanism of the solving means 4.

[0030]

[Function]

Since the above-mentioned rotating table drives by the above-mentioned gear drive via the infinite variable-speed drive of an intermediate shaft, the revolving speed of a rotating table is stepless and is adjusted.

Since a churning operation of the agitating device by the solving means 4 is adjusted with the rotating velocity of an impeller, and the revolving speed of a mixing vessel, it can adjust a churning operation suitably according to the kind of fluid to be agitated, the churning purpose, churning lapsed time, etc. by adjusting the revolving speed of a rotating table with an infinite variable-speed drive.

Since the hand of cut of a rotating table is reversed and the revolving speed can be adjusted if it is made the gearbox which can reverse the above-mentioned infinite variable-speed drive, it is still wide range and the strength of a churning operation can be adjusted with the roll control of a rotating table.

[0031]

[Embodiment of the Invention]

[Work example 1]

Sag of the two axes 2 and 2 is carried out by the wheel base L from the epicyclic-gear gearing, and

the impeller 1 is attached to the axes 2 and 2 of this couple, respectively. These impellers 1 and 1 are fields where that side is linear to a lengthwise direction.
It is mutually turned in the right-angled direction, and the axes 2 and 2 rotate in the direction at uniform velocity.

The major axis 1a of the impeller 1 of this example is 71 mm, and the minor axis 1b is 35 mm. And although the curved surface shape of the side of an impeller can be chosen suitably, when both the impellers 1 and 1 rotate, in a total rotary place, the major-axis end of one impeller has a relation which touches the side of the impeller of another side mostly.
[0032]
Namely, when it is as an example of the form of the impeller 1 and the plane shape of the two impellers 1 and 1 being shown in drawing 14 (a) and two impellers in this thing have a right-angled relation mutually, When distance between the axes of rotation of two impellers is set to L, the curvature radius of the impeller side curved surface is set to R and the major-axis end circle radius of an impeller is set to alpha, It is L=R+alpha, R=L-alpha, and alpha=L-R, and when distance of the center of the curvature radius R of the impeller side curved surface and an impeller shaft center is set to C, it can compute by C=root2 (L/2-alpha). If the inside diameter of the mixing vessel at this time is set to D, it will be set to D=2(C+alpha)+L, and that center will serve as the middle point between the two axes of rotation.
Drawing 14 (b) sets the wheel base L to 50, is an example when the major-axis end circle radius alpha is set to 3, and is set to R=50-3=47, C=root2(50 / 2-3)=31.113, and D=2(31.113+3) +50=118.226.
Drawing 14 (c) sets the wheel base L to 50, shows plane shape in case the major-axis end which set the major-axis end circle radius alpha to 0 is edge shape, and is set to R=50-0=50 in this case, C=root2(50 / 2-0)=35.355, and D=2(35.355+0)+50=120.71.
[0033]
Although the viscous fluid in the mixing vessel 3 is agitated by the impellers 1 and 1 of the above-mentioned couple, the inside diameter A of the mixing vessel 2 in this example is 124 mm, and the depth is 55 mm.
Relative rotating of the impeller of a couple is carried out in the direction in the mode of drawing 3 (a), (b), and (c). It slides so that the above-mentioned side may be ground, after the tip end part of one impeller 1 contacted mostly and has contacted in the lengthwise direction straight line to the side of the impeller 1 of another side at this time. Therefore, the flow of viscous fluid around which it takes and turns to the arrow direction of drawing 3 with one impeller will be severed by the impeller of another side, and will be pushed back in the direction contrary to the flow. The viscous fluid adhering to the flank part of the impeller of another side fails to be scratched by the point of one impeller. And the side which it fails to scratch of the two impellers so that change of drawing 3 (a), (b), and (c) may show, Since the side in which the side which fails to be scratched takes the place one by one by rotation, and one impeller fails to be scratched is also changed one by one by rotation of an impeller, the viscous fluid adhering to the both side surfaces of two impellers will fail to be scratched intermittently.
Since the major-axis end of the impeller 1 of this example slides on the inner surface of the mixing vessel 3 intermittently and the impellers 1 and 1 revolve around the sun within a mixing vessel, the viscous fluid adhering to the inner surface of the mixing vessel also fails to be intermittently scratched by the tip of an impeller.
[0034]
Only 50 cc (viscous degree 80 Pa-s), feed 100 cc (viscous degree 100 Pa-s) and the ink for lithography (yellow) into the mixing vessel 3, and the ink for lithography (cyanogen) under 25 ** temperature, By 76 rotating velocity/of an impeller, when [20 revolution speed] agitating by a part for /, as compared with the case (the conditions) where it is based on the conventional agitating

device, the churning time is mostly shortened to 1/10.
Although churning unevenness is not avoided in conventional technology, churning unevenness is completely solved in this example.
[0035]
Next, the rising and falling mechanism of the impeller drive by the epicyclic-gear gearing of this embodiment and an agitating device, etc. are explained.
Impeller drives are epicyclic-gear dynamo-electric means of the form which the flywheel starter gear 4 are being fixed to the support plate 14, and the carrier of a planet gear drives with an electric motor.
The support plate 14 is guided by the two guide supports 21 and 21, enabling free rise and fall. The vertical screw-thread axis 23 is among the guide supports 21 and 21, the lower end is supported by the buck 20 by a bearing, enabling free rotation, and the upper part is supported by the bearing by the side between the guide supports 21 and 21, enabling free rotation. And **** on the screw-thread axis 23, the sleeve 22 is made to have screwed, and this screw-thread sleeve 22 is being fixed to the support plate 14.
The flywheel starter gear 4 are being fixed to the undersurface of the support plate 14 with the screw 14a, and the upper bed of the cylindrical carrier 9 is supported by these flywheel starter gear 4 via the bearing 10.
The carrier 9 is held via the bearing 10 at the flywheel starter gear 4, enabling free rotation.
The two vertical axes 2 and 2 are supported by this carrier 9 via the bearings 8 and 8, enabling free rotation.

The driving shaft 15 was inserted in the center hole of the carrier 9, it has adhered, and the upper bed is connected with the axis of the electric motor 18 via the coupling 17, enabling free attachment and detachment.
[0036]
The planet gears 5 and 5 have adhered to the upper bed of the vertical axes 2 and 2, respectively, and these planet gears 5 and 5 have geared to the above-mentioned flywheel starter gear 4. The vertical axes 2 and 2 are caudad prolonged from the lower end of the carrier 9, and the lower end is inserted in the center hole of the above-mentioned impellers 1 and 1. In this example, the impeller electrode holder 7 has adhered to the upper bed side of the impeller 1, and this impeller electrode holder 7 has adhered to the vertical axes 2 and 2 by the pin, enabling free attachment and detachment.
As mentioned above, since the vertical axes 2 and 2 are held via the bearings 8 and 8 at the carrier 9, the carrier 9 is held via the bearing 10 at the flywheel starter gear 4, the flywheel starter gear 4 **** and it is being fixed to the support plate 14 by 14a, If the screw-thread axis 23 is rotated by the handle 24 and you make it go up and down the support plate 14, a drive will go up and down with this, and an impeller will go up and down. By raising an impeller, when the impeller 1 escapes to the upper part and drops it from the mixing vessel 3, the impeller 1 is inserted into the mixing vessel 3.
[0037]
The mixing vessel 3 is a cylindrical body, that lower end has the flange 3a, and the flat-surface part 3b of the couple which opposes this flange 3a is formed. On the other hand, the upper surface of the buck 20 has a crevice of form into which the flange 3a of the mixing vessel 3 gets densely, the above-mentioned flange will get into this crevice, and the mixing vessel 3 will be held at the buck 20 at rotation impossible.
[0038]
The driving shaft 15 drives via the coupling 17 with the axis of an electric motor, the carrier 9 drives by this, and the revolution drive of the vertical axes 2 and 2 is carried out by rotation of the carrier 9. Since the planet gear which has adhered to the upper bed of the vertical axes 2 and 2 has geared to the flywheel starter gear 4, while the vertical axes 2 and 2 rotate, it will revolve around the sun.

And the two above-mentioned planet gears are the same, and since it has geared to the same flywheel starter gear 4, the revolving speed of both the vertical axes 2 and 2 is equal, and revolves the same orbit top around the sun.
[0039]
[Work example 2]
Subsequently, the example of the agitating device by the solving means 2 is explained.
This Embodiment 2 does not have a difference in particular with the above-mentioned Embodiment 1 except for the point that the side of an impeller is a screw type-like side. The upper bed side of the impeller of this thing is in the position which shifted to the hand of cut 90 degrees to the lower end surface, and the side in the meantime and end rim are a screw type.
The plane shape of this thing and side form are as being shown in drawing 9 (a) and (b), and the section A-A in drawing 9 (b), B-B, C-C, D-D, and E-E are as being shown in drawing 10 (A) - (E), respectively.
All of such sectional shape are the same.

The elliptical (not the thing that says a strict ellipse but form which resembled the ellipse mostly) outline of the end face of the impeller 31 of this example, It is the form drawn by major axis of 71 mm, and 35 mm of minor axes with the common inscribed circle arc z and the partial circle of the above-mentioned imaginary circle x to the imaginary circle x with a radius of 4.77 mm of major-axis both ends, and the imaginary circle y with a main radius of 17.5 mm. The height of this impeller 31 is 50 mm. The overview of this thing is as being shown in drawing 11.
[0040]
By the same appearance as the case where two screws (screw-thread stick) gear mutually, the two impellers 31 and 31 are put together mutually, are arranged, and rotate at uniform velocity in the direction like Embodiment 1. A fluid is agitated at this time, the impeller 31 spiral-like side extruding at the method of the outside of a radial direction, and a slanting lower part (or slanting upper part). And since it exercises for a counter direction mutually while a major axis direction end spiral to one impeller slides on the spiral side of the impeller of another side mutually in the state where it contacted mostly, it is failed to scratch the viscous fluid adhering to the spiral side of the impeller of above-mentioned another side at the major axis direction end of above-mentioned one impeller. Since the impeller 31 extrudes in a direction with the velocity component of a turning direction, and the velocity component of the lengthwise direction strongly and a complicated flow is generated between the mixing vessel 3 and the impellers 31 and 31, the viscous fluid in the mixing vessel 3 has a very high stirring effect. Therefore, what is called a Weissenberg effect generated when the degree of viscosity mixes a greatly different substance (a unique flow phenomenon: if a stick is thrust in and stirred in a solution, an oil level will be cratered in a Newton liquid, but.) In a non-Newtonian liquid, the phenomenon which goes up by carrying out can be controlled so that it may rise conversely and may coil around a stick, and even when the degree of viscosity mixes a greatly different substance, churning and mixing are made very efficiently.
[0041]
As for the impellers 31 and 31 of the agitating device shown in drawing 7 and drawing 8, it is needless to say that it drives with the drive by the epicyclic-gear driving mechanism shown in drawing 4 thru/or drawing 6, both impellers are made to rotate and revolve around the sun, and the viscous fluid in the mixing vessel 3 can be agitated. However, as for the screw type-like two impellers 31 and 31, since the churning operation is powerful, a stirring effect is enough demonstrated only by rotation. Therefore, viscous fluid can fully be agitated only by rotation of the impellers 31 and 31 in a short time.
The churning drive only by rotation of the impellers 31 and 31 is shown in drawing 12. This thing is supported by the support plate 42 currently supported by the guide supports 41 and 41 enabling free rise and fall, enabling free rotation of the gear drive 43.

The vertical axis of the impellers 31 and 31 is supported enabling free rotation.
The pinion 44 has adhered to this vertical axis, respectively, and the pinion concerned has geared with the gear drive 43.
Since the pinion 44 will drive at uniform velocity in the direction if the driving shaft 45 of the gear drive 43 is driven with an electric motor, the impellers 31 and 31 drive at uniform velocity in the direction.
[0042]
The example of other drives is explained with reference to drawing 13. This drive also drives the mixing vessel 3 simultaneously with an impeller to the example of drawing 12 driving the impellers 31 and 31. In the pinion 44, the opposite hand is made to have supported the intermediate shaft 51, enabling the free rotation to the support plate 42, and the pinion 52 which adhered to the upper bed of this intermediate shaft is engaged to the gear drive 43. On the other hand, the buck 60 is made to have supported the rotating table 61, enabling free rotation, and this rotating table 61 is made to attach the mixing vessel 3 like Embodiment 1, enabling free attachment and detachment. And the gear 61a is formed in the peripheral face of the rotating table 61, and the pinion 53 which adhered to the gear 61a concerned in the lower end of the intermediate shaft 51 has geared.
Therefore, the rotating table 61 drives to the impeller 3 and a counter direction via the intermediate shaft 51 and the pinions 52 and 53 by the gear drive 43, therefore the mixing vessel 3 drives to the impeller 3 and a counter direction.
[0043]
Since high viscous fluid corotates to an arrow direction and the impeller 31 rotates to a counter direction with this by rotation of the mixing vessel 3, a stirring effect improves further. Since a stirring effect changes by adjusting revolving speed of an impeller, and revolving speed of the mixing vessel 3, A stirring effect can be minutely adjusted to the intermediate shaft 51 according to character of a fluid in the mixing vessel 3, and the churning purpose by making an easy infinite variable-speed drive by friction roller, a V belt, etc. intervene, and adjusting revolving speed of the mixing vessel 3 by this.
[0044]

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]The top view of the important section of ******** 1.
[Drawing 2]The perspective view of the important section of ******** 1.
[Drawing 3]The top view showing the operating state of ******** 1.
[Drawing 4]The important section top view of the impeller drive of ******** 1.
[Drawing 5]Drawing of longitudinal section of ******** 1.
[Drawing 6]Drawing of longitudinal section of the important section of the impeller drive of ******** 1.
[Drawing 7]The top view of the important section of ******** 2.
[Drawing 8]The perspective view of the important section of ******** 2.
[Drawing 9](a) is a top view of the impeller of Embodiment 2, and (b) is a side view of the impeller.
[Drawing 10](A) - (E) is a section A-A in Fig. 9 (b) - a sectional view of E-E.
[Drawing 11]The whole impeller outline view of ******** 2.
[Drawing 12]The perspective view of Embodiment 2 showing an example of a ****** drive.
[Drawing 13]The perspective view of Embodiment 2 showing other examples of **********.
[Drawing 14](a) and (b) are the top views for explaining an example of the plane shape of the impeller in an embodiment.
(b) is a top view for explaining other examples of plane shape, and (c) is a top view for explaining the example of further others.

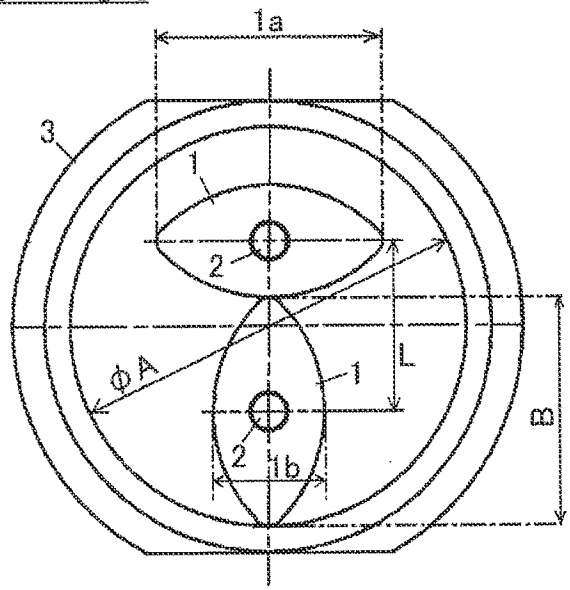
[Explanations of letters or numerals]
1: Impeller
2: Vertical axis
3: Mixing vessel
4: Flywheel starter gear
5: Planet gear
7: Impeller electrode holder
8: Bearing
9: Carrier
10: Bearing
14: Support plate
15: Driving shaft
17: Coupling
20: Buck
21: Guide support
23: Screw-thread axis
31: Impeller

41: Guide support
42: Support plate
43: Gear drive
44: Pinion
45: Driving shaft
51: Intermediate shaft
52, 53: Pinion
60: Buck
61: Rotating table
61a: Gear

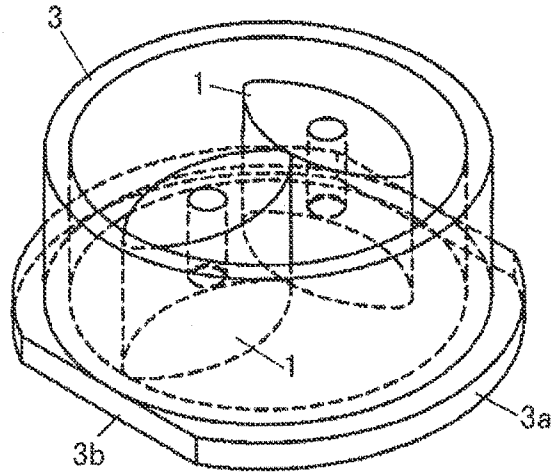
[Translation done.]

DRAWINGS

[Drawing 1]



[Drawing 2]



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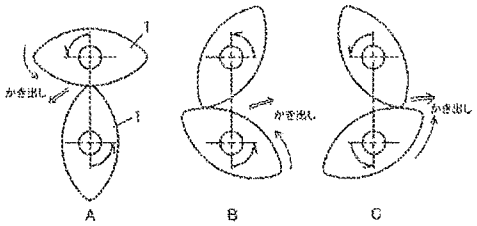
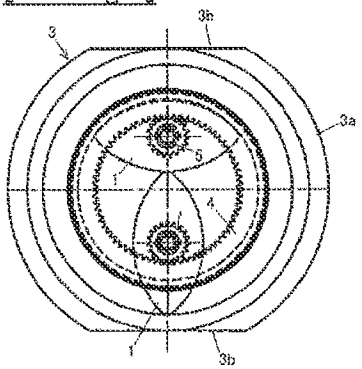
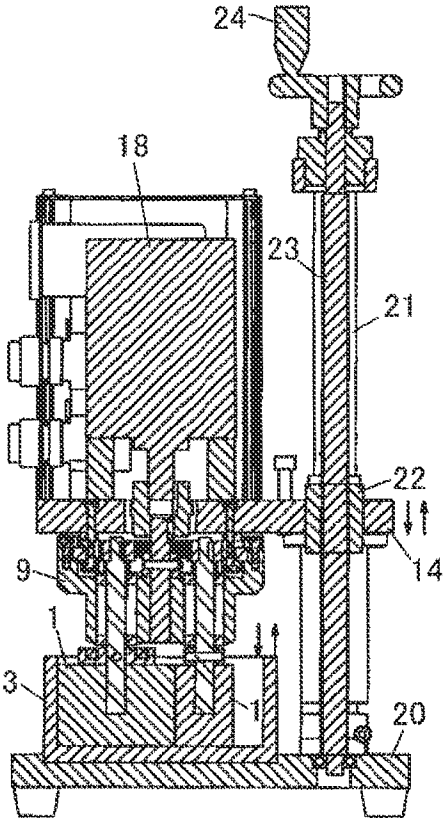


[Drawing 4]



[Drawing 5]



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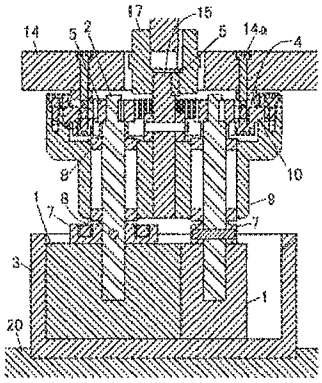

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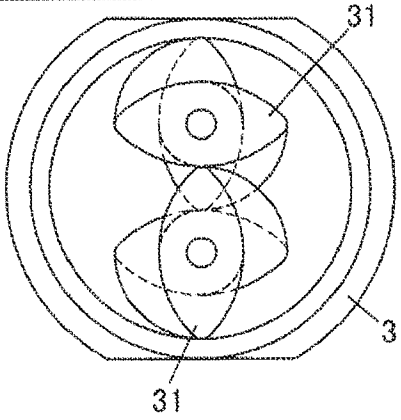
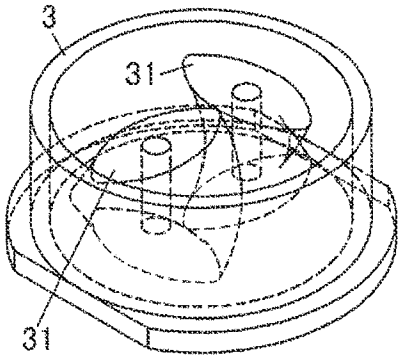
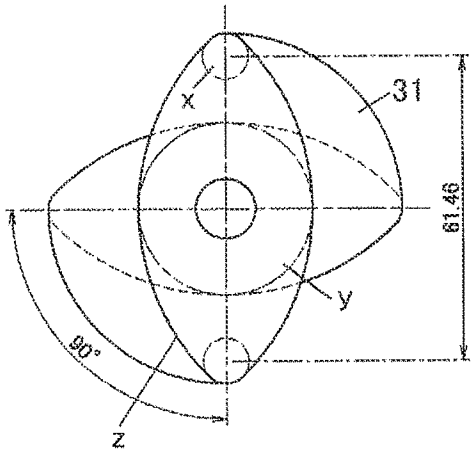


[Drawing 8]



[Drawing 9]

(a)



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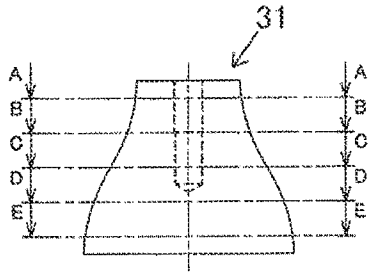
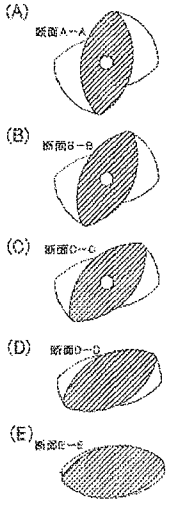
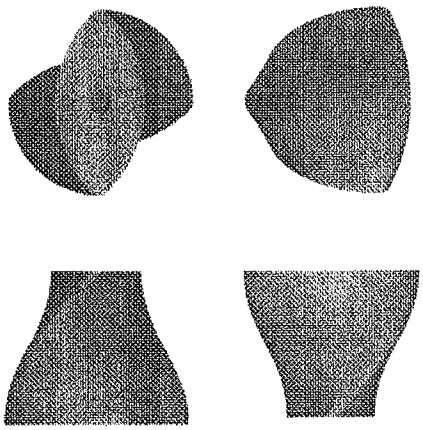


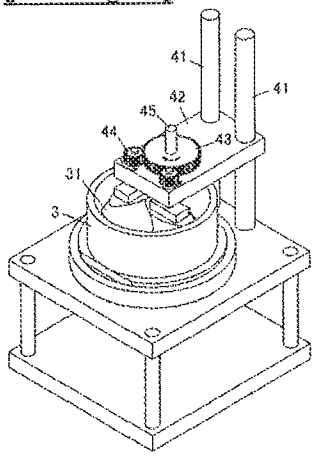
[Drawing 10]



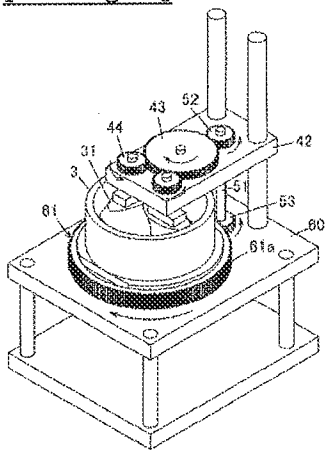
[Drawing 11]



[Drawing 12]

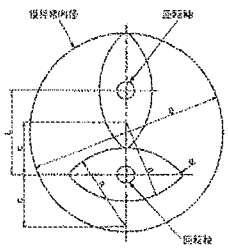


[Drawing 13]



[Drawing 14]

(a)



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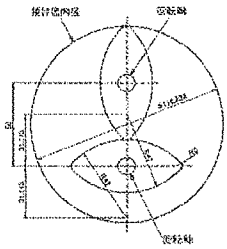
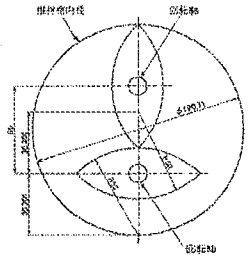


(c)



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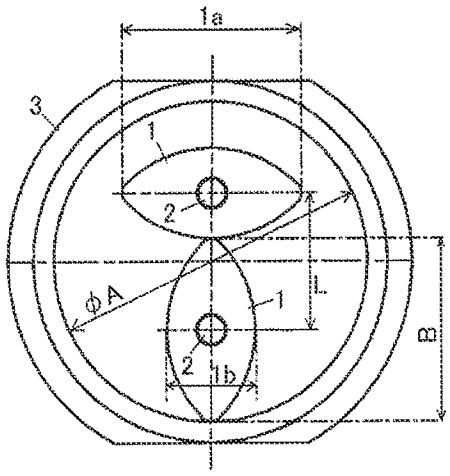
最終頁に続く

(54)【発明の名称】二軸撹拌装置

(57)【要約】　（修正有）
【課題】二軸撹拌翼による高粘性流体の撹拌装置について、撹拌される流体の連れ回りを確実に防止し、かつ、撹拌翼表面に付着して撹拌されない部分が発生することを確実に防止できるような、一対の撹拌翼の形状を提供する。
【解決手段】一対の縦軸撹拌翼１を縦置き撹拌槽３内で自転させて、上記撹拌槽３内の高粘性流体を撹拌・混合する撹拌装置を前提として、撹拌翼１の水平断面が縦軸２を中心としたほぼ楕円形状であり、上記楕円形状の長径長さの１／２と短径長さの１／２の和が軸間距離に等しく、一方の撹拌翼１と他方の撹拌翼１の回転位相が９０度ずれていて、等角速度で同方向に回転し、撹拌翼１の側曲面形状が、全回転位置において一方の撹拌翼１の先端部が他方の撹拌翼１の側面部分にほぼ接する形状であること。
【選択図】　図１



【特許請求の範囲】
【請求項1】
一対の縦軸撹拌翼を縦置き撹拌槽内で自転させて、上記撹拌槽内の高粘性流体を撹拌・混合する撹拌装置において、
撹拌翼の水平断面が縦軸を中心としたほぼ楕円形状であり、
上記楕円形状の長径長さの１／２と短径長さの１／２の和が軸間距離に等しく、
一方の撹拌翼と他方の撹拌翼の回転位相が９０度ずれていて、同角速度で同方向に回転し、
撹拌翼の側曲面形状が、全回転位置において一方の撹拌翼の先端部が他方の撹拌翼の側面部分にほぼ接する形状である撹拌装置。
【請求項2】
二つの撹拌軸が自転とともに公転する請求項１の撹拌装置。
【請求項3】
上記撹拌翼の楕円形状の長径長さが軸間距離の１／２よりも長く、軸間を結ぶ線上において縦撹拌槽に内接する長さにほぼ等しい、請求項２の撹拌装置。
【請求項4】
上記撹拌翼の側面が縦方向に直線的な面である請求項１の撹拌装置。
【請求項5】
上記撹拌翼の側面が螺旋形状の面である請求項１の撹拌装置。
【請求項6】
上記一対の撹拌翼の自転・公転駆動機構が、１対の同一遊星ギヤを備えた遊星歯車伝動機構のキャリヤに両撹拌翼軸を回転自在に支持させ、両撹拌翼軸を、上記遊星ギヤでそれぞれ駆動し、上記キャリヤを回転自在に支持部材に支持させ、当該キャリヤの回転中心を、位置決めされて固定された撹拌槽の中心に一致させたものである、請求項２の撹拌装置。
【請求項7】
上記遊星歯車伝動機構が、キャリヤをフリーにし、リングギヤまたは太陽ギヤを駆動ギヤとしたものである、請求項６の撹拌装置。
【請求項8】
上記遊星歯車伝動機構が、キャリヤを駆動部材とし、リングギヤまたは太陽ギヤを固定ギヤとしたものである、請求項６の撹拌装置。
【請求項9】
上記撹拌翼に対する撹拌槽の位置決め機構が、支持台上面に非円形凹部を設け、当該非円形凹部に同形状の撹拌槽の下端を嵌合させ、撹拌槽を支持台に着脱自在に固定したものである、請求項６の撹拌装置。
【請求項10】
上記遊星歯車伝動機構の支持装置が、遊星歯車伝動機構を案内支柱に昇降自在に支持させ、送りねじ機構によって昇降駆動するようにしたものである、請求項５の撹拌装置。
【請求項11】
支持部材に駆動ギヤを回転自在に支承させ、一対の撹拌軸及び中間軸を回転自在に支承させ、
上記駆動ギヤで一対の撹拌軸及び上記中間軸のピニオンを駆動し、
支持台に歯車付きの回転テーブルを設け、当該回転テーブルに撹拌槽を着脱自在に装着し、
回転テーブルの歯車を上記中間軸下端のピニオンで駆動する、請求項５の撹拌装置。
【請求項12】
上記中間軸に無段変速装置を介在させた請求項１１の撹拌装置。

【発明の詳細な説明】
【０００１】
【産業上の利用分野】
この発明は、比較的粘性度の高い流体を撹拌する撹拌装置に関するものであり、縦置きの

円筒上の撹拌槽内の粘性流体を二つの撹拌翼で撹拌する撹拌装置について、撹拌槽の流体をむらなく均等に、能率的に撹拌・混合することができるものであり、比較的ゆっくりと撹拌翼を回転させながら、複数の高粘性流体を短時間で高精度かつ均等に混合することができるものである。

【０００２】

【従来の技術】

高粘性流体に限らず様々な流体を縦置きの円筒状撹拌槽に入れて、これを縦型の撹拌翼で撹拌する撹拌装置には様々な機構のものがある。その一つは一軸撹拌翼によるものであり、その一例が特開平８－７１３９８号公報に記載されている。このような撹拌装置における撹拌翼の形状構造は、螺旋状の細板によるもの、平板状の縦板によるものなど様々であるが、上記公報に記載されているものは、縦方向撹拌機能と横方向撹拌機能とを共に有する板状撹拌翼を、回転方向に位相を順次ずらして多段に設けたものであり、これによって、上下方向の撹拌能率を高めて、高粘性流体の撹拌性能を向上させたものである。

また、二軸撹拌翼を備えたものとして、例えば、特開２００２－１１３３４４号公報に記載されているものがあり、このものは、大小２つの螺旋状撹拌翼を自転させながら公転させることによって、撹拌効率を高めたものである。

【０００３】

一軸撹拌翼によるもの、二軸撹拌翼によるもののいずれについても、個々の撹拌翼が個々に独立して撹拌槽内で自転し、あるいは自転・公転してこれを回転方向、あるいは回転方向及び縦方向に撹拌するものである。

撹拌装置における撹拌翼は、その表面が撹拌槽内の流体に対して回転するものであって、翼表面に接している流体に剪断力が作用するけれども、比較的粘性度が高い流体（以下これを「高粘性流体」という）の場合は、その粘着性のために撹拌翼表面から剥離せず、そのため引きずられ、この引きずり力が広範囲に及んで、周りの流体が連れ回される（共回りする）ことになる。また、撹拌翼表面に付着したままの層もある。このため、全体として撹拌・混合能率が極めて悪く、また、ほとんど撹拌・混合されない部分が残存し、その結果、撹拌・混合精度が悪く、仮に撹拌時間を長くしても均一に撹拌・混合することができない場合もある。

【０００４】

【解決しようとする課題】

そこで、この発明は、二軸撹拌翼による高粘性流体の撹拌装置について、撹拌される流体の連れ回りを確実に防止し、かつ、撹拌翼表面に付着して撹拌されない部分が発生することを確実に防止できるように、一対の撹拌翼の形状を工夫することを、その課題１とするものである。

【０００５】

さらに、一対の撹拌翼で撹拌槽内の流体に、旋回方向及び縦方向の一定の経路に沿った流れを強制して、撹拌槽内の流体に均等な撹拌作用が与えられる様に、一対の撹拌翼の形状を工夫することを、その課題２とするものである。

【０００６】

さらに、一対の撹拌翼が、撹拌槽内の流体に均等に撹拌作用を及ぼす様に、その駆動機構を工夫することを、その課題３とするものである。

【０００７】

【課題を解決しようとする手段】

【解決手段１】（請求項１に対応）

上記課題１を解決するために講じた手段（解決手段１）は、一対の縦軸撹拌翼を縦置き撹拌槽内で自転させて、上記撹拌槽内の高粘性流体を撹拌・混合する撹拌装置を前提として、次の（イ）乃至（ニ）によって構成されるものである。

（イ）撹拌翼の水平断面が縦軸を中心としたほぼ楕円形状であること、

（ロ）上記楕円形状の長径長さの１／２と短径長さの１／２の和が軸間距離に等しいこと

（ハ）一方の撹拌翼と他方の撹拌翼の回転位相が９０度ずれていて、等角速度で同方向に回転すること、
（ニ）撹拌翼の側曲面形状が、全回転位置において一方の撹拌翼の先端部が他方の撹拌翼の側面部分にほぼ接する形状であること。
なお、上記の「ほぼ楕円形状」は、いわゆる楕円形状ではなく、長径と短径とを有する楕円に似た形状を意味する。
また、上記の「高粘性流体」は、撹拌翼に粘着して、撹拌翼の表面に粘着した流体層が形成される程度の粘性度を有する流体を意味する。
【０００８】
【作用】
一対の撹拌翼が、その一方の先端部分が他方の側面にほぼ接した状態で同方向に回転するので、一方の撹拌翼の自転に連れて回る流れ（共回り）が、他方の撹拌翼によって遮断されるので、他方の撹拌翼の回転力の影響領域へ移り、その後、再び一方の撹拌翼の回転力の影響領域へ移動する。したがって、一つの撹拌翼の自転に引きずられて当該撹拌翼を中心とする旋回流が生じることはない。被撹拌流体は上記のような移動（流れ）を繰り返しながら撹拌槽の中で撹拌されることになる。
【０００９】
また、一方の撹拌翼の側面に対して他方の撹拌翼の先端部分がほぼ接した状態で、互いに反対方向に回転するので、一方の撹拌翼の側面に付着した層が他方の撹拌翼によって掻き落とされて、上記他方の撹拌翼による撹拌領域へ押しやられる。そして、上記一方の撹拌翼の両側面のそれぞれに対する掻き落としは、１回転毎に１回の割合で繰り返される。したがって、撹拌翼の側面に一旦付着した流体もその直後に確実に撹拌されることになる。
さらに、撹拌翼の断面形状の長径長さの１／２と短径長の１／２の和が軸間距離にほぼ等しいので、撹拌槽の中心部分も撹拌翼の自転による撹拌領域内にあることになる。
【００１０】
【実施態様１】（請求項２に対応）
実施態様１は、解決手段１の撹拌装置について、撹拌軸を自転とともに公転させることである。
【００１１】
【作用】
一対の撹拌翼が撹拌槽内で自転しながら公転するので、撹拌槽内の流体全体に撹拌作用が均等に及び、また、個々の撹拌翼が定位置で自転する場合に比して、粘性流体が連れ回る傾向が小さいので、撹拌速度が一層向上する。
【００１２】
【実施態様２】（請求項３に対応）
実施態様２は、上記実施態様１の撹拌翼について、その楕円形状の長径長さが軸間距離の１／２よりも長く、軸間を結ぶ線上において縦撹拌槽に内接する長さにほぼ等しいことである。
【００１３】
【作用】
撹拌翼は公転しながら、その自転によって撹拌槽の内面に繰り返し接するので、撹拌槽の内面についても、付着した流体が撹拌翼の先端で掻き落とされて、撹拌翼による撹拌領域へ戻されるので、一旦撹拌槽の内面に付着した流体も確実に撹拌されることになる。
したがって、撹拌槽の全ての部分が撹拌翼の自転・公転による撹拌領域になって均等に撹拌される。
【００１４】
【実施態様３】（請求項４に対応）
実施態様３は、上記解決手段１における撹拌翼の側面を縦方向に直線的な面にしたことである。
【００１５】

【作用】
撹拌翼の側面が縦方向に直線的な面であるから、粘性流体が撹拌翼の自転によって回転方向前方に押され、翼面にそって半径方向外方に押し出されながら撹拌される。このとき、一方の撹拌翼の先端部が他方の撹拌翼の側面に対して縦方向の直線に沿ってほぼ線接触した状態で、回転方向に摺動することになり、上記他方の撹拌翼の側面に付着している粘性流体を回転方向前方に向けて掻き出すことになる。
撹拌翼の側面が縦方向に直線的な面であるから、その形状は比較的単純であり、したがって、製作は比較的容易である。
【００１６】
【解決手段２】（請求項５に対応）
上記課題２を解決するために講じた手段（解決手段２）は、上記解決手段１における撹拌翼の側面が螺旋形状の面であることである。
【００１７】
【作用】
撹拌翼の側面が螺旋形状の面であるから、撹拌翼がスクリューとして機能し、粘性流体が撹拌翼の自転によって掻き回されるだけではなく、翼面にそって半径方向外方、及び斜め下方（回転方向によっては斜め上方）に押し出されながら撹拌される。このように、粘性流体が掻き回されながら積極的に上下方向に撹拌されるので、撹拌槽内に複雑な流れを生じ、これによって撹拌が促進される。
一方の撹拌翼の先端部は螺旋形状であって、他方の撹拌翼の螺旋状側面に対して縦方向の螺旋に沿ってほぼ線接触した状態で、螺旋方向に摺動することになり、上記他方の撹拌翼の側面に付着している粘性流体を回転方向前方かつ斜め下方に向けて掻き出すことになる。
【００１８】
なお、上記螺旋形状の螺旋ピッチは任意であるが、螺旋ピッチが小さいほど流体を下方に押し出す作用が増大し、他方抵抗も増大する。他方、螺旋ピッチが小さいほど下方への押し出し速度が低下する。このピッチと撹拌翼の撹拌性能との関係は、撹拌翼の回転速度、撹拌される流体の粘性度などの物性にもよるので、最適ピッチは一概には決められない。したがって、必要な撹拌度合い、撹拌時間等に応じて、個々に最適の螺旋ピッチを選択する他はない。
【００１９】
【解決手段３】（請求項６に対応）
上記課題３を解決するために講じた手段（解決手段３）は、上記解決手段１の実施態様１について、その一対の撹拌翼を自転及び公転させる駆動機構を、次の（イ）（ロ）及び（ハ）によって構成したことである。
（イ）一対の同一遊星ギヤを備えた遊星歯車伝動機構のキャリヤに両撹拌翼軸を回転自在に支持させたこと、
（ロ）両撹拌翼軸を、上記遊星ギヤでそれぞれ駆動すること、
（ハ）上記キャリヤを回転自在に支持部材に支持させ、当該キャリヤの回転中心を、位置決めされて固定された撹拌槽の中心に一致させたこと。
【００２０】
【作用】
遊星歯車伝動機構のキャリヤの回転中心が撹拌槽の中心に一致しているので、二つの撹拌翼が対となって同方向に等速度で自転しながら、撹拌槽に対する同心円に沿って公転する。したがって、一対の撹拌翼による撹拌作用が撹拌槽内の流体に均等に及び、撹拌槽内の流体が均等に撹拌される。
【００２１】
【実施態様１】（請求項７に対応）
実施態様１は、上記解決手段３の遊星歯車伝動機構について、キャリヤをフリーにし、リングギヤまたは太陽ギヤを駆動ギヤとしたことである。

【００２２】
【実施態様２】（請求項８に対応）
実施態様２は、上記解決手段３の遊星歯車伝動機構について、キャリヤを駆動部材とし、リングギヤまたは太陽ギヤを固定ギヤとしたことである。
【００２３】
【実施態様３】（請求項９に対応）
実施態様３は、上記解決手段３における撹拌翼に対する撹拌槽の位置決め機構について、支持台上面に非円形凹部を設け、当該非円形凹部に同形状の撹拌槽の下端を嵌合させ、撹拌槽を上記支持台に着脱自在に固定したことである。
【００２４】
【作用】
遊星歯車伝動装置の回転中心と支持台上面の非円形凹部の中心とを一致させた状態で遊星歯車伝動装置の支持装置と上記支持台とを固定することで、支持台上面の非円形凹部の中心と遊星歯車伝動装置の回転中心とが一致しているので、支持台上面の非円形凹部に同形状の撹拌槽の下端を嵌合させることによって、遊星歯車伝動装置の回転中心と撹拌槽の中心とは常に一致する。
したがって、メンテナンス時の撹拌槽の組み付けを簡単、容易にすることができる。
【００２５】
【実施態様４】（請求項１０に対応）
実施態様４は、上記実施態様３における遊星歯車伝動機構の支持装置について、遊星歯車伝動機構を案内支柱によって昇降自在に支持させ、送りねじ機構によって昇降駆動するようにしたことである。
【００２６】
【作用】
上記送りねじ機構で上記支持体を上昇させることによって、遊星歯車伝動機構とともに撹拌翼を引き上げて撹拌槽から上方に取り出すことができ、また下降させることによって、遊星歯車伝動機構とともに撹拌翼を押し下げて撹拌槽に上方から挿入することができる。この撹拌翼の撹拌槽に対する脱着操作の間も、撹拌翼と撹拌槽との位置関係は案内支柱によって維持されるから、再装着時に撹拌翼と撹拌槽の位置調整を行う必要はない。
【００２７】
【解決手段４】（請求項１１に対応）
上記課題３を解決するために講じた他の手段（解決手段４）は、上記解決手段２による撹拌装置の駆動機構を、次の（イ）乃至（ニ）によって構成したことである。
（イ）支持部材に駆動ギヤを回転自在に支承させ、一対の撹拌軸及び中間軸を回転自在に支承させたこと、
（ロ）上記駆動ギヤで一対の撹拌軸及び上記中間軸のピニオンを駆動すること、（ハ）支持台に歯車付きの回転テーブルを設け、当該回転テーブルに撹拌槽を着脱自在に装着すること、
（ニ）回転テーブルの歯車を上記中間軸下端のピニオンで駆動すること。
【００２８】
【作用】
一対の撹拌軸は上記駆動ギヤによって同方向に等速度で駆動される。他方、回転テーブルは、中間軸を介して上記駆動ギヤで駆動されるから、撹拌軸とは反対方向に駆動される。したがって、撹拌槽が撹拌翼とは反対方向に駆動される。
そして、撹拌槽の回転によってその中の粘性流体が撹拌翼とは反対方向に旋回するので、撹拌翼による撹拌効果が撹拌槽内の粘性流体に均等に及び、撹拌効果、撹拌速度が顕著に向上する。
【００２９】
【実施態様１】（請求項１２に対応）
実施態様１は、解決手段４の駆動機構について、上記中間軸に無段変速装置を介在させた

ことである。
【００３０】
【作用】
上記回転テーブルが中間軸の無段変速装置を介して上記駆動ギヤで駆動されるので、回転テーブルの回転速度が無段階で調整される。
解決手段４による撹拌装置の撹拌作用は、撹拌翼の自転速度と撹拌槽の回転速度とによって加減されるから、無段変速装置で回転テーブルの回転速度を加減することによって、被撹拌流体の種類、撹拌目的、撹拌経過時間などに応じて、適宜撹拌作用を調整することができる。
また、上記無段変速装置を逆転可能な変速装置にすれば、回転テーブルの回転方向を逆転させ、かつその回転速度を加減できるので、回転テーブルの回転制御によって、撹拌作用の強弱をさらに広範囲で調整することができる。
【００３１】
【実施の形態】
【実施例１】
遊星歯車伝動装置から軸間距離Ｌで２つの軸２，２が垂下されており、この一対の軸２，２に撹拌翼１がそれぞれ取り付けられている。この撹拌翼１，１は、その側面が縦方向に直線的な面であり、互いに直角の方向に向けられていて、軸２，２が等速度で同方向に回転する。
この例の撹拌翼１の長径１ａは７１ｍｍ、短径１ｂは３５ｍｍである。そして、撹拌翼の側面の曲面形状は適宜選択できるが、両撹拌翼１，１が回転するとき、全回転位置において一方の撹拌翼の長径端部が他方の撹拌翼の側面にほぼ接する関係にあるものである。
【００３２】
すなわち、撹拌翼１の形状と、２つの撹拌翼１，１の平面形状の一例を図１４（ａ）に示すとおりであり、このものにおける２つの撹拌翼が互いに直角の関係にあるときに、２つの撹拌翼の回転軸間距離をＬとし、撹拌翼側曲面の曲率半径をＲとし、撹拌翼の長径端部円弧半径をαとしたとき、Ｌ＝Ｒ＋α、Ｒ＝Ｌ－α、α＝Ｌ－Ｒであり、撹拌翼側曲面の曲率半径Ｒの中心と撹拌翼回転軸中心の距離をＣとしたとき、$C=\sqrt{2}(L/2-\alpha)$で算出することができる。また、この時の撹拌槽の内径をＤとすると、Ｄ＝２（Ｃ＋α）＋Ｌとなり、その中心は２つの回転軸間の中点となる。
図１４（ｂ）は軸間距離Ｌを５０とし、長径端部円弧半径αを３としたときの例であり、Ｒ＝５０－３＝４７、$C=\sqrt{2}(50/2-3)=31.113$、Ｄ＝２（３１．１１３＋３）＋５０＝１１８．２２６となる。
図１４（ｃ）は軸間距離Ｌを５０とし、長径端部円弧半径αを０とした長径端部がエッジ状の場合の平面形状を示すものであり、この場合のＲ＝５０－０＝５０、$C=\sqrt{2}(50/2-0)=35.355$、Ｄ＝２（３５．３５５＋０）＋５０＝１２０．７１となる。
【００３３】
上記一対の撹拌翼１，１で撹拌槽３の中の粘性流体を撹拌するのであるが、この例における撹拌槽２の内径Ａは１２４ｍｍであり、深さは５５ｍｍである。
一対の撹拌翼は、図３（ａ）（ｂ）（ｃ）の態様で同方向に相対回転する。このとき一方の撹拌翼１の先端部分が他方の撹拌翼１の側面に対して縦方向直線でほぼ接触し、接触した状態で上記側面を擦るように摺動する。したがって、一方の撹拌翼とともに図３の矢印方向に連れ回る粘性流体の流れは、他方の撹拌翼によって断たれ、また、その流れと逆の方向に押し返されることになる。また、他方の撹拌翼の側面部分に付着している粘性流体が一方の撹拌翼の先端部で掻き落とされる。そして、図３（ａ）（ｂ）（ｃ）の変化から解るように、二つの撹拌翼のうちの掻き落とす側と、掻き落とされる側とが回転によって順次交替し、また、一つの撹拌翼の掻き落とされる側面も撹拌翼の回転によって順次交替するので、二つの撹拌翼の両側面に付着する粘性流体は間欠的に掻き落とされることになる。
この例の撹拌翼１の長径端部が撹拌槽３の内面に間欠的に摺動し、かつ撹拌翼１，１は撹

拌槽内で公転するので、撹拌槽の内面に付着した粘性流体も撹拌翼の先端によって間欠的に掻き落とされる。

【００３４】

平版印刷用インク（シアン）を１００ｃｃ（粘性度１００Ｐａ・ｓ）、平版印刷用インク（イエロー）を５０ｃｃ（粘性度８０Ｐａ・ｓ）だけ撹拌槽３に投入して、温度２５℃の下で、撹拌翼の自転速度７６回／分、公転速度２０回／分で撹拌するとき、従来の撹拌装置による場合（同条件）に比して、その撹拌時間がほぼ１／１０に短縮される。

また、従来技術では撹拌むらが避けられないが、この例では、撹拌むらが全く解消する。

【００３５】

次に、この実施例の遊星歯車伝動装置による撹拌翼駆動装置、及び撹拌装置の昇降機構などについて説明する。

撹拌翼駆動装置は、リングギヤ４が支持板１４に固定されていて、遊星ギヤのキャリヤが電動モータで駆動される形式の遊星歯車電動装置である。

支持板１４は２つの案内支柱２１，２１で昇降自在に案内されている。案内支柱２１，２１の間に縦のねじ軸２３があって、その下端が支持台２０にベアリングによって回転自在に支持され、上部が案内支柱２１，２１間の横板に軸受によって回転自在に支持されている。そしてねじ軸２３にねじスリーブ２２を螺合させてあり、このねじスリーブ２２が支持板１４に固定されている。

支持板１４の下面にリングギヤ４がネジ１４ａで固定されており、このリングギヤ４に円筒状のキャリア９の上端が、ベアリング１０を介して支持されている。

キャリア９は、ベアリング１０を介してリングギヤ４に回転自在に保持されており、このキャリア９に２つの縦軸２，２がベアリング８，８を介して回転自在に支持されている。

キャリア９の中心穴に駆動軸１５が挿入されて固着されており、その上端がカップリング１７を介して、電動モータ１８の軸に着脱自在に連結されている。

【００３６】

縦軸２，２の上端に遊星ギヤ５，５がそれぞれ固着されており、この遊星ギヤ５，５が上記リングギヤ４に噛み合っている。また、縦軸２，２はキャリア９の下端から下方に延びていて、その下端が上記撹拌翼１，１の中心穴に嵌め込まれている。この例では撹拌翼１の上端面に撹拌翼ホルダー７が固着されていて、この撹拌翼ホルダー７がピンによって縦軸２，２に着脱自在に固着されている。

上記のように、縦軸２，２はベアリング８，８を介してキャリア９に保持されており、キャリア９がベアリング１０を介してリングギヤ４に保持され、リングギヤ４がねじ１４ａによって支持板１４に固定されているので、ねじ軸２３をハンドル２４で回転させて支持板１４を昇降させると、これとともに駆動装置が昇降し、また、撹拌翼が昇降する。撹拌翼を上昇させることによって撹拌翼１が撹拌槽３から上方に脱出し、下降させることによって撹拌翼１が撹拌槽３内に挿入される。

【００３７】

撹拌槽３は円筒体であり、その下端にフランジ３ａがあって、このフランジ３ａに対抗する一対の平面部３ｂが設けられている。他方、支持台２０の上面に撹拌槽３のフランジ３ａが密に嵌まり込む形状の凹部があり、この凹部に上記フランジが嵌まり込んで、撹拌槽３が回転不能に支持台２０に保持されることになる。

【００３８】

電動モータの軸によってカップリング１７を介して駆動軸１５が駆動され、これによってキャリヤ９が駆動され、キャリヤ９の回転によって縦軸２，２が公転駆動される。縦軸２，２の上端に固着されている遊星ギヤが、リングギヤ４に噛み合っているので、縦軸２，２が自転しながら公転することになる。

そして、上記二つの遊星ギヤが同じものであり、同じリングギヤ４に噛み合っているので、両縦軸２，２の回転速度は等しく、同じ軌道上を公転する。

【００３９】

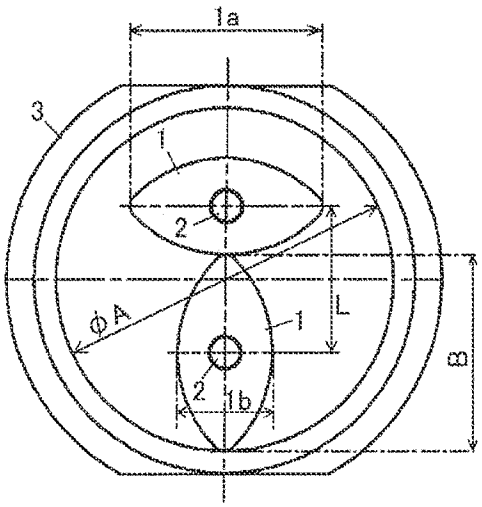
【実施例２】

次いで、解決手段２による撹拌装置の例について説明する。
この実施例２は撹拌翼の側面が螺旋形状の面である点を除き、上記実施例１と特に違いはない。このものの撹拌翼の上端面は下端面に対して９０度回転方向にずれた位置にあり、その間の側面及び端縁は螺旋形である。
このものの平面形状、側面形状は図９（ａ）（ｂ）に示すとおりであり、図９（ｂ）における断面Ａ－Ａ，Ｂ－Ｂ，Ｃ－Ｃ，Ｄ－Ｄ，Ｅ－Ｅは、図１０（Ａ）～（Ｅ）にそれぞれ示すとおりであり、これらの断面形状は全て同じである。
この例の撹拌翼３１の端面の楕円形状（厳密な楕円をいうものではなく、ほぼ楕円に似た形状）の概略は、長径７１ｍｍ、短径３５ｍｍで、長径両端の半径４．７７ｍｍの仮想円ｘと中心の半径１７．５ｍｍの仮想円ｙに対する共通内接円弧ｚと、上記仮想円ｘの一部円弧とで描かれる形状である。また、この撹拌翼３１の高さは５０ｍｍである。このものの全体像は図１１に示すとおりである。
【００４０】
２つの撹拌翼３１，３１は２つのスクリュー（ねじ棒）が互いにかみ合う場合と同様の格好で互いに合わされて配置され、実施例１と同様に、同方向に等速度で回転する。このとき、流体は撹拌翼３１螺旋状の側面によって半径方向外方及び斜め下方（又は斜め上方）に押し出されながら撹拌される。そして、一方の撹拌翼に螺旋状の長径方向端部が他方の撹拌翼の螺旋状側面にほぼ当接した状態で互いに滑り合いながら、互いに反対方向に運動するので、上記他方の撹拌翼の螺旋側面に付着した粘性流体を上記一方の撹拌翼の長径方向端部で掻き落とす。
撹拌槽３内の粘性流体は撹拌翼３１によって、旋回方向の速度成分と縦方向の速度成分をもった方向に強く押し出されて、撹拌槽３と撹拌翼３１，３１との間に複雑な流れが生成されるので、撹拌効果が極めて高い。したがって、粘性度が大きく異なる物質を混合するときに発生する、いわゆるワイゼンベルク効果（特異な流動現象：溶液中に棒を突っ込んで掻き回すと、ニュートン液体では液面がへこんでしまうが、非ニュートン液体では逆に盛り上がってきて棒に巻き付くようして上っていく現象）を抑制することができ、粘性度が大きく異なる物質を混合する場合でも極めて能率的に撹拌・混合がなされる。
【００４１】
図７，図８に示す撹拌装置の撹拌翼３１，３１は、図４乃至図６に示す遊星歯車伝動機構による駆動装置で駆動して、両撹拌翼を自転・公転させて、撹拌槽３内の粘性流体を撹拌できるのは勿論である。しかし、螺旋形状の二つの撹拌翼３１，３１は、その撹拌作用が強力であるので、自転のみで撹拌効果が十分発揮される。したがって、撹拌翼３１，３１の自転のみで粘性流体を短時間で十分に撹拌することができる。
撹拌翼３１，３１の自転のみによる撹拌駆動装置を図１２に示している。このものは、案内支柱４１，４１に昇降自在に支持されている支持板４２に駆動ギヤ４３が回転自在に支持されており、また撹拌翼３１，３１の縦軸が回転自在に支持されている。この縦軸にそれぞれピニオン４４が固着されていて、当該ピニオンが駆動ギヤ４３と噛み合っている。駆動ギヤ４３の駆動軸４５を電動モータで駆動すると、ピニオン４４が同方向に等速度で駆動されるので、撹拌翼３１，３１が同方向に等速度で駆動される。
【００４２】
図１３を参照して他の駆動装置の例を説明する。この駆動装置は図１２の例が撹拌翼３１，３１を駆動するのに対して、撹拌翼と共に撹拌槽３をも同時に駆動するものである。ピニオン４４とは反対側に中間軸５１を支持板４２に回転自在に支持させてあって、この中間軸の上端に固着したピニオン５２を駆動ギヤ４３に噛み合わせている。他方、支持台６０に回転テーブル６１を回転自在に支持させてあり、この回転テーブル６１に撹拌槽３を実施例１と同様に着脱自在に嵌着させている。そして回転テーブル６１の外周面にギヤ６１ａを設けてあり、当該ギヤ６１ａに中間軸５１の下端に固着したピニオン５３が噛み合っている。
したがって、駆動ギヤ４３によって中間軸５１、ピニオン５２，５３を介して、回転テーブル６１が、撹拌翼３と反対方向に駆動され、したがって、撹拌翼３と反対方向に撹拌槽

３が駆動される。
【００４３】
撹拌槽３の回転によって高粘性流体が矢印方向に共回りし、これとは反対方向に撹拌翼３１が自転するので、撹拌効果が一層向上する。撹拌翼の回転速度と撹拌槽３の回転速度とを調整することによって撹拌効果が変化するから、中間軸５１に、摩擦ローラ、Ｖベルトなどによる簡単な無段変速装置を介在させ、これによって撹拌槽３の回転速度を加減することによって、撹拌効果を撹拌槽３内の流体の性質、撹拌目的に応じて、微細に調整することができる。
【００４４】
【発明の効果】
この発明の効果を整理すれば次のとおりである。
１．第１番目の発明の効果
解決手段１による発明（請求項１に係る発明）は、一対の撹拌翼が同方向に回転し、一方の撹拌翼の長径端部が他方の撹拌翼の側面にほぼ当接した状態でこすり合いながら回転することによって、個々の撹拌翼の回転に連れて共回りする流体の流れを他方の撹拌翼によって遮断して、共回りを阻止し、当該共回り方向とは反対の方向に押し返すものである。このようにして押し返された流体は上記他方の撹拌翼の撹拌領域へ移動して、これによって撹拌される。また、上記他方の撹拌翼の側面に付着した流体の層を上記一方の撹拌翼の長径端部で掻き落とされて、一方の撹拌翼の撹拌領域へ誘導され、これによって撹拌される。
したがって、撹拌槽内の流体はまんべんなく均等に撹拌される。
【００４５】
２．第２番目の発明の効果
解決手段２による発明（請求項５に係る発明）は、撹拌翼の側面が螺旋面であって、一対の撹拌翼が同方向に回転し、一方の撹拌翼の長径端部が他方の撹拌翼の側面にほぼ当接した状態でこすり合いながら回転することによって、個々の撹拌翼の回転に連れて共回りする流体の流れを他方の撹拌翼によって遮断して、共回りを阻止し、当該共回り方向とは反対の方向に押し返すものである。
水平断面形状がほぼ楕円形状であって、その側面が螺線形であるから、その自転によって、流体の下方（回転方向によっては上方）に強く押し出されるので、粘性流体に上下方向の強い流れを生じる。
自転に伴う撹拌と、上下方向の流れによる撹拌とによって、粘性流体が方向を変えながら複雑な経路で流れるので、撹拌が一層促進される。
【００４６】
３．第３番目の発明の効果
解決手段３による発明（請求項６に係る発明）は、一対の撹拌撹拌翼を遊星歯車伝導装置によって駆動して、これを自転・公転させるものであるから、簡単な駆動機構によって一対の撹拌翼を等速度で回転させ、かつ同軌道上で公転させることができる。したがって、駆動機構の製造コストを低減でき、また、駆動装置の小型軽量化が図られる。
【００４７】
４．第４番目の発明の効果
解決手段４による発明（請求項１１に係る発明）は、撹拌翼を自転させるとともに撹拌槽を回転させるものであるから、撹拌翼の自転だけで撹拌効果を生じさせるものに比して、著しく撹拌効果が高く、撹拌槽の回転駆動機構を極めて単純であるから、自転・公転させる形式のものにして撹拌性能は格別違わないが、駆動装置を著しく単純にすることができる。
また、撹拌翼の回転速度を一定にしたままで、撹拌槽の回転速度を調整することによって撹拌性能を適宜調整することができる。
【図面の簡単な説明】
【図１】は実施例１の要部の平面図。

【図２】は実施例１の要部の斜視図。
【図３】は実施例１の動作状態を示す平面図。
【図４】は実施例１の撹拌翼駆動装置の要部平面図。
【図５】は実施例１の縦断面図。
【図６】は実施例１の撹拌翼駆動装置の要部の縦断面図。
【図７】は実施例２の要部の平面図。
【図８】は実施例２の要部の斜視図。
【図９】（ａ）は実施例２の撹拌翼の平面図、（ｂ）は同撹拌翼の側面図。
【図１０】（Ａ）～（Ｅ）は、第９図（ｂ）における断面Ａ－Ａ～Ｅ－Ｅの断面図。
【図１１】は実施例２の撹拌翼の全体外観図。
【図１２】は撹拌駆動装置の一例を示す実施例２の斜視図。
【図１３】は撹拌装置の他の例を示す実施例２の斜視図。
【図１４】（ａ）（ｂ）は、実施例における撹拌翼の平面形状の一例を説明するための平面図であり、（ｂ）は平面形状の他の例を説明するための平面図であり、（ｃ）はさらに他の例を説明するための平面図である。
【符号の説明】
１：撹拌翼
２：縦軸
３：撹拌槽
４：リングギヤ
５：遊星ギヤ
７：撹拌翼ホルダー
８：ベアリング
９：キャリヤ
１０：ベアリング
１４：支持板
１５：駆動軸
１７：カップリング
２０：支持台
２１：案内支柱
２３：ねじ軸
３１：撹拌翼
４１：案内支柱
４２：支持板
４３：駆動ギヤ
４４：ピニオン
４５：駆動軸
５１：中間軸
５２，５３：ピニオン
６０：支持台
６１：回転テーブル
６１ａ：ギヤ

【図1】



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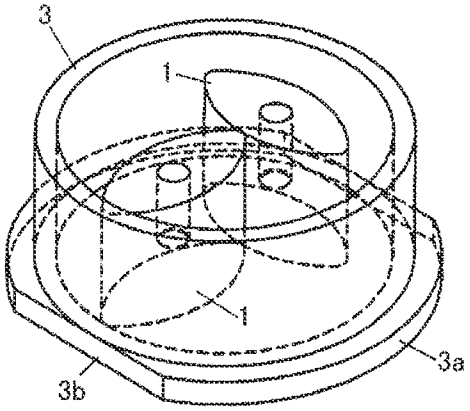

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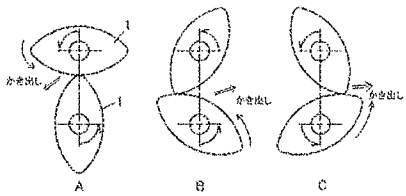

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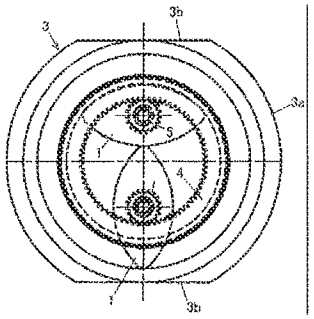

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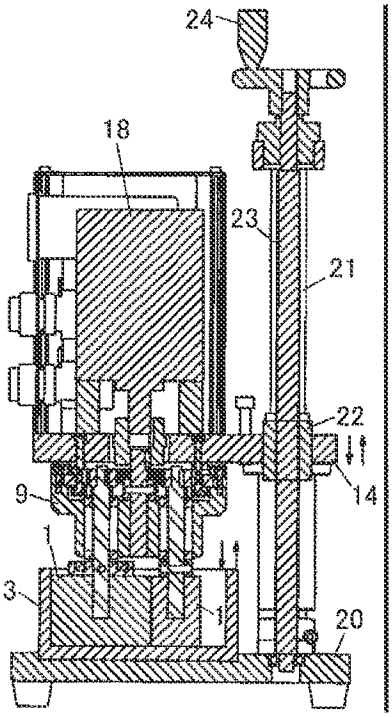

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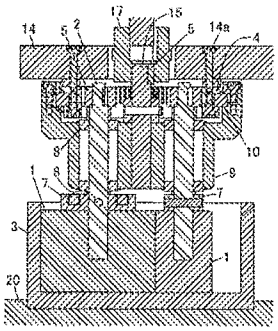

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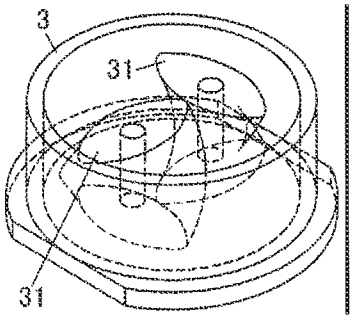

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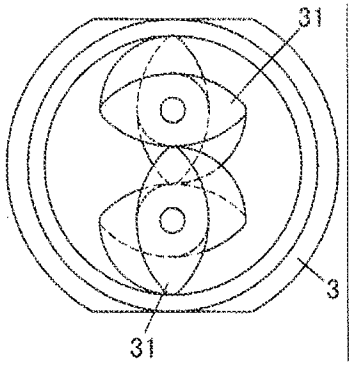
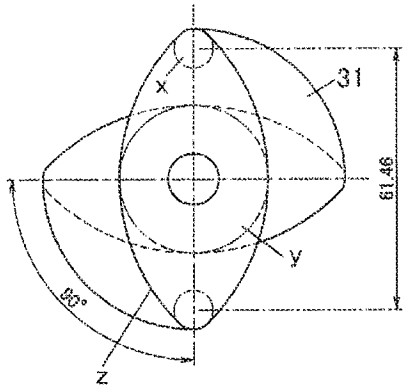
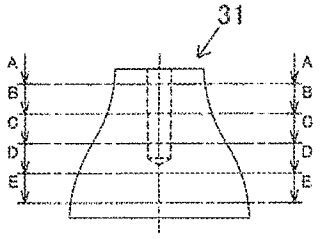


【図9】

(a)



(b)



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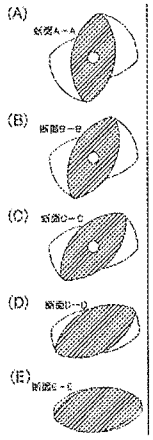

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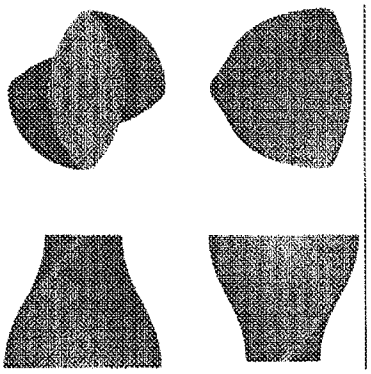

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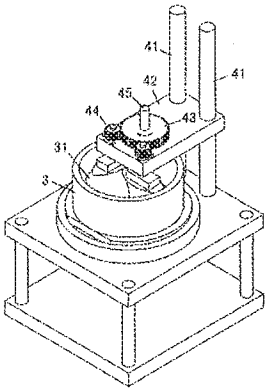

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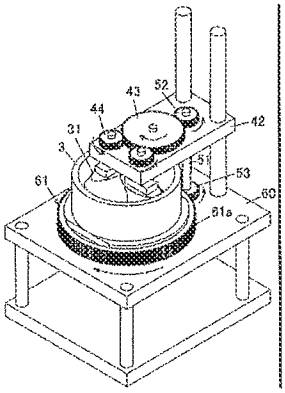
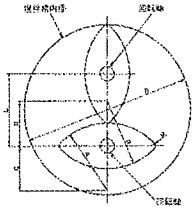


【図14】

(a)



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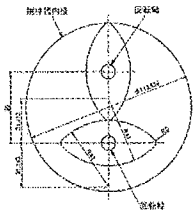
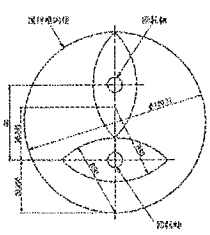


(c)



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DB04 DB10